Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
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Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.82m²

Site Reference : Lawnwood House **Plot Reference:** Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	30.36 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.56 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.6 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

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6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: West	7.53m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	

Output from water heater (annual)$_{1...12}$ 2035.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.5	84.06	90.1	83.29	83.45	77.19	76.63	80.65	79.43	86.25	88.03	93.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	127.02	125.1	121.11	115.69	112.17	107.21	103	108.4	110.31	115.93	122.26	125.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	381.73	379.69	368.04	349.47	330.84	312.86	301.21	306.73	316.31	335.06	356.51	372.37	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	426.93	468.1	513.65	561.83	591.1	579.28	554.85	524.6	485.65	439.98	412.86	409.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.75	0.58	0.63	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.86	20.1	20.44	20.74	20.93	20.98	20.97	20.84	20.46	20.04	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.85	0.65	0.45	0.5	0.79	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.21	18.41	18.76	19.25	19.65	19.87	19.91	19.91	19.79	19.29	18.68	18.19	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.11	19.42	19.83	20.18	20.38	20.44	20.43	20.3	19.86	19.34	18.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.11	19.42	19.83	20.18	20.38	20.44	20.43	20.3	19.86	19.34	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.51	0.56	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	424.37	463.44	502.82	531.21	509.54	402.41	282.98	293.85	395.4	421.73	408.29	407.51	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1131.25	1095.08	993.11	831.89	644.28	435.75	288.91	303.09	468.95	703.98	933.77	1127.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	525.92	424.46	364.78	216.49	100.24	0	0	0	0	209.99	378.35	535.76	(98)

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	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2755.98 (98)
Space heating requirement in kWh/m²/year		43.87 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		249.9 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	525.92	424.46	364.78	216.49	100.24	0	0	0	0	209.99	378.35	535.76	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	210.45	169.85	145.97	86.63	40.11	0	0	0	0	84.03	151.4	214.39	(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1102.83 (211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0 (215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from water heater (calculated above)	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	
Efficiency of water heater													175.1 (216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	112.72	99.59	105.17	95.07	93.74	84.59	82.03	88.92	88.43	98.54	103.2	110.27	
Total = Sum(219a)$_{1...12}$ =													1162.28 (219)

Annual totals		**kWh/year**	**kWh/year**
Space heating fuel used, main system 1			1102.83
Water heating fuel used			1162.28
Electricity for pumps, fans and electric keep-hot			
central heating pump:		30	(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30 (231)
Electricity for lighting			314.64 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211)	x	0.519	=	572.37 (261)
Space heating (secondary)	(215)	x	0.519	=	0 (263)

DER WorkSheet: New dwelling design stage

Water heating	(219) x	0.519	=	603.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1175.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1354.46	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.56	(273)
EI rating (section 14)				83	(274)

Predicted Energy Assessment

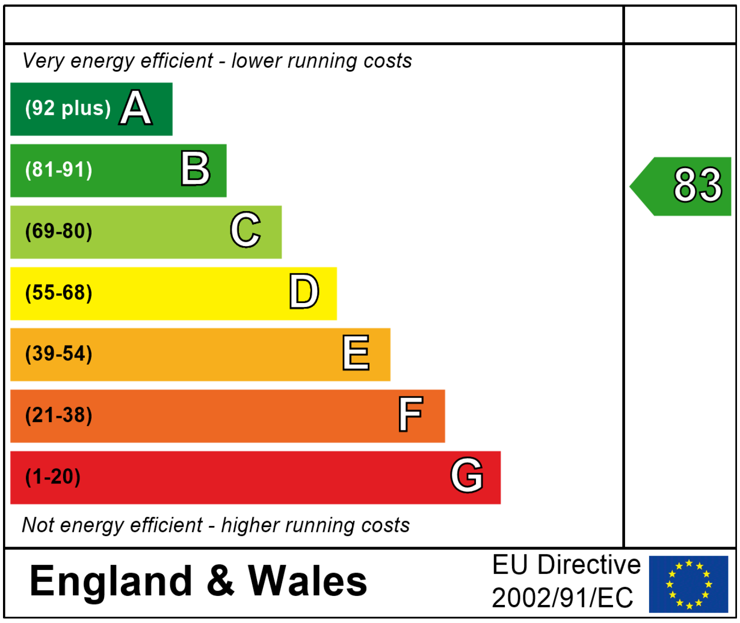
Flat 1
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type: Mid floor Flat
Date of assessment: 20 April 2020
Produced by: Benjamin Leech
Total floor area: 62.82 m²

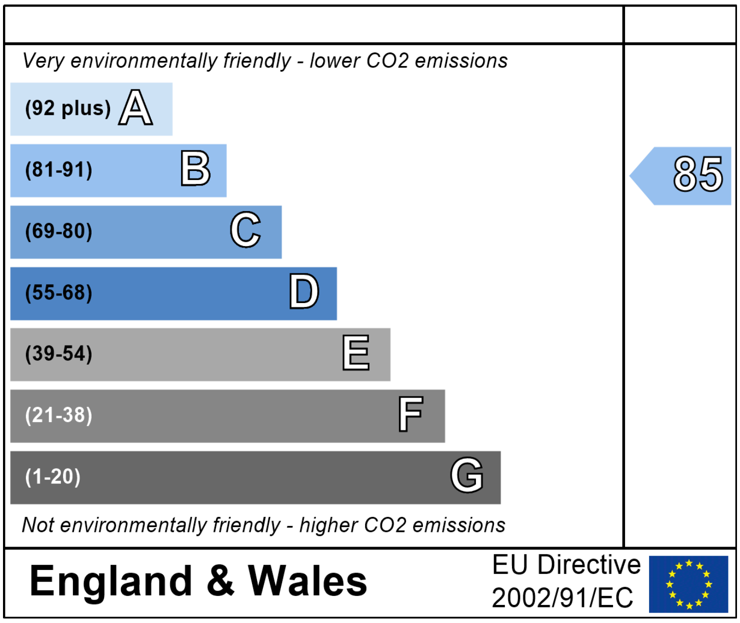
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1\ldots12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1\ldots12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1\ldots12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1\ldots12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.72	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.59	19.73	19.98	20.33	20.65	20.89	20.97	20.96	20.77	20.35	19.91	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.58	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.75	19	19.35	19.66	19.86	19.91	19.91	19.78	19.38	18.94	18.6	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.77	0.59	0.65	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.95	376.03	420.37	460.46	460.15	381.55	277.55	285.13	354.43	346.28	322.04	318.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.13	1103.74	997.78	831.86	641.8	434.05	288.36	302.23	465.84	702.92	939.19	1138.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	600.54	489.02	429.59	267.41	135.15	0	0	0	0	265.33	444.35	610.41	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3241.79 (98)

Space heating requirement in kWh/m²/year 51.6 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.11	557.44	571.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.8	0.87	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	563.94	487.65	482.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	66.5	104.47	81.58	0	0	0	0

Total = Sum(104)$_{6...8}$ = 252.55 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	16.63	26.12	20.39	0	0	0	0

Total = Sum(107)$_{6...8}$ = 63.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.01 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 52.61 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = $Sum(40)_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = $Sum(44)_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = $Sum(45)_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.79	20.03	20.37	20.69	20.9	20.98	20.96	20.8	20.39	19.96	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.84	19.09	19.43	19.73	19.91	19.95	19.95	19.83	19.45	19.02	18.69	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.57	0.63	0.88	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.98	376.05	420.32	459.89	457.56	375.32	270.37	278.53	351.77	346.11	322.06	318.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1104.52	1067.38	964.98	804.41	620.66	419.54	278.85	292.27	450.67	679.88	908.08	1101.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.54	464.57	405.23	248.06	121.35	0	0	0	0	248.33	421.93	582.23	

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Total per year (kWh/year) = Sum(98)1...5,9...12 = 3064.24 (98)

Space heating requirement in kWh/m²/year 48.78 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	680.63	535.82	549.37	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.82	0.89	0.86	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	556.93	478.18	474.36	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m														
(104)m=	0	0	0	0	0	71.55	111.51	87.45	0	0	0	0		
									Total = Sum(104)6...8 =				270.51	(104)
Cooled fraction									f C = cooled area ÷ (4) =				1	(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104)6...8 =				0	(106)
Space cooling requirement for month = (104)m × (105) × (106)m														
(107)m=	0	0	0	0	0	17.89	27.88	21.86	0	0	0	0		
									Total = Sum(107)6...8 =				67.63	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =				1.08	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	49.85	(109)
Target Fabric Energy Efficiency (TFEE)		57.33	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = $Sum(39)_{1...12}$ /12= 76.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22	

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	
									Total = Sum(44)$_{1…12}$ =			997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	
									Total = Sum(45)$_{1…12}$ =			1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	

Output from water heater (annual)$_{1...12}$ 2035.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.5	84.06	90.1	83.29	83.45	77.19	76.63	80.65	79.43	86.25	88.03	93.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	44.54	39.56	32.17	24.36	18.21	15.37	16.61	21.59	28.98	36.79	42.94	45.78	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	268.66	271.44	264.42	249.46	230.58	212.84	200.99	198.2	205.22	220.18	239.06	256.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	127.02	125.1	121.11	115.69	112.17	107.21	103	108.4	110.31	115.93	122.26	125.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	533.84	529.72	511.32	483.13	454.58	429.05	414.22	421.81	438.14	466.52	497.88	521.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	579.03	618.14	656.93	695.49	714.84	695.47	667.86	639.68	607.49	571.43	554.24	558.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.92	0.82	0.65	0.49	0.53	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.07	20.29	20.59	20.83	20.96	20.99	20.99	20.91	20.62	20.23	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.95	0.9	0.77	0.56	0.37	0.41	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	18.71	19.03	19.44	19.75	19.89	19.92	19.92	19.85	19.5	18.96	18.5	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.37	19.64	20	20.27	20.41	20.44	20.44	20.37	20.04	19.58	19.19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.37	19.64	20	20.27	20.41	20.44	20.44	20.37	20.04	19.58	19.19	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.43	0.47	0.71	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	567.97	601.09	624.98	624.51	563.19	419.55	286.53	299.48	433.03	518.69	536.33	549.29	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1151.74	1114.75	1010.62	845.08	651.52	437.89	289.36	303.79	473.82	717.66	951.94	1147.69	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	434.33	345.18	286.91	158.8	65.72	0	0	0	0	148.03	299.24	445.21	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2183.43	(98)
Space heating requirement in kWh/m²/year	34.76	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	434.33	345.18	286.91	158.8	65.72	0	0	0	0	148.03	299.24	445.21		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	173.8	138.13	114.81	63.55	26.3	0	0	0	0	59.24	119.74	178.16		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													873.72	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	112.72	99.59	105.17	95.07	93.74	84.59	82.03	88.92	88.43	98.54	103.2	110.27		
Total = Sum(219a)$_{1...12}$ =													1162.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			873.72	
Water heating fuel used			1162.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			314.64	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	115.24	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)

Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	153.31	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	41.5	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	314.01	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.22	(257)
SAP rating (Section 12)		82.94	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO_2/kWh		**Emissions** kg CO_2/year	
Space heating (main system 1)	(211) x	0.519	=	453.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	603.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1056.69	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO_2, kg/year		sum of (265)…(271) =		1235.55	(272)
CO_2 emissions per m²		(272) ÷ (4) =		19.67	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2682.33	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3568.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6250.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	965.93	(268)
'Total Primary Energy		sum of (265)…(271) =		7308.57	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		116.34	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1\ldots12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1...12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1...12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1...12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07	

Output from water heater (annual)$_{1...12}$ 1917.21 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.49	76.83	82.09	75.54	75.44	69.44	68.62	72.63	71.67	78.23	80.27	85.06	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	116.24	114.32	110.34	104.92	101.4	96.44	92.23	97.62	99.54	105.15	111.49	114.33	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	370.96	368.92	357.27	338.7	320.07	302.09	290.43	295.96	305.53	324.29	345.74	361.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	416.16	457.33	502.88	551.06	580.33	568.51	544.08	513.83	474.88	429.21	402.09	398.77	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.74	0.57	0.62	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.77	19.9	20.14	20.47	20.76	20.94	20.99	20.98	20.86	20.49	20.08	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.85	0.65	0.44	0.49	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.5	18.85	19.32	19.71	19.91	19.95	19.95	19.84	19.36	18.76	18.28	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.02	19.18	19.48	19.88	20.22	20.41	20.46	20.45	20.34	19.91	19.4	19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.02	19.18	19.48	19.88	20.22	20.41	20.46	20.45	20.34	19.91	19.4	19	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.5	0.55	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	413.92	453.14	492.79	521.46	499.42	391.91	274.36	285.15	386.19	412.13	398.03	397.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.65	1058.63	960.02	803.91	622.5	420.81	279.24	292.89	453.09	680.23	902.32	1089.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	505.72	406.89	347.62	203.37	91.57	0	0	0	0	199.47	363.09	515.42	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2633.14	(98)
Space heating requirement in kWh/m²/year	41.92	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	505.72	406.89	347.62	203.37	91.57	0	0	0	0	199.47	363.09	515.42		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	540.88	435.18	371.78	217.51	97.94	0	0	0	0	213.33	388.33	551.25		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2816.2	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07		
Efficiency of water heater													79.8	(216)
(217)m=	87.33	87.12	86.62	85.51	83.48	79.8	79.8	79.8	79.8	85.36	86.77	87.43		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	214.52	189.77	201.02	183.34	184.63	173.46	167.43	182.57	181.88	190.41	197.07	209.4		
Total = Sum(219a)$_{1...12}$ =													2275.52	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2816.2	
Water heating fuel used			2275.52	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	608.3	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	491.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1099.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1302.03	(272)

TER =	30.36	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:36:25

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.82m²

Site Reference : Lawnwood House **Plot Reference:** Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity		
Fuel factor: 1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	30.36 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.06 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.6 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: West	7.53m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m^2)			Av. Height(m)			Volume(m^3)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1\ldots12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1...12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	
										Total = Sum(44)$_{1...12}$ =		997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	
										Total = Sum(45)$_{1...12}$ =		1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	

Output from water heater (annual)$_{1…12}$ 2035.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.5	84.06	90.1	83.29	83.45	77.19	76.63	80.65	79.43	86.25	88.03	93.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	127.02	125.1	121.11	115.69	112.17	107.21	103	108.4	110.31	115.93	122.26	125.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	381.73	379.69	368.04	349.47	330.84	312.86	301.21	306.73	316.31	335.06	356.51	372.37	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	426.93	468.1	513.65	561.83	591.1	579.28	554.85	524.6	485.65	439.98	412.86	409.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.75	0.58	0.63	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.86	20.1	20.44	20.74	20.93	20.98	20.97	20.84	20.46	20.04	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.85	0.65	0.45	0.5	0.79	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.21	18.41	18.76	19.25	19.65	19.87	19.91	19.91	19.79	19.29	18.68	18.19	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.11	19.42	19.83	20.18	20.38	20.44	20.43	20.3	19.86	19.34	18.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.11	19.42	19.83	20.18	20.38	20.44	20.43	20.3	19.86	19.34	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.51	0.56	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	424.37	463.44	502.82	531.21	509.54	402.41	282.98	293.85	395.4	421.73	408.29	407.51	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1131.25	1095.08	993.11	831.89	644.28	435.75	288.91	303.09	468.95	703.98	933.77	1127.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	525.92	424.46	364.78	216.49	100.24	0	0	0	0	209.99	378.35	535.76	

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2755.98 (98)
Space heating requirement in kWh/m²/year	43.87 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	525.92	424.46	364.78	216.49	100.24	0	0	0	0	209.99	378.35	535.76		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	210.45	169.85	145.97	86.63	40.11	0	0	0	0	84.03	151.4	214.39		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1102.83	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	112.72	99.59	105.17	95.07	93.74	84.59	82.03	88.92	88.43	98.54	103.2	110.27		
Total = Sum(219a)$_{1...12}$ =													1162.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1102.83	
Water heating fuel used			1162.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			314.64	(232)
Electricity generated by PVs			-666.19	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	572.37	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	603.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1175.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Energy saving/generation technologies Item 1		0.519	=	-345.75	(269)
Total CO2, kg/year	sum of (265)…(271) =			1008.71	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			16.06	(273)
EI rating (section 14)				87	(274)

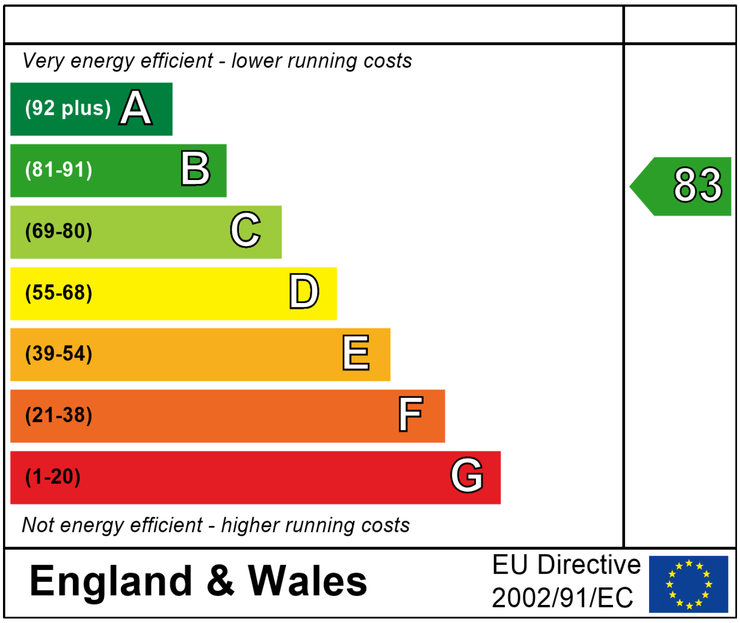
Predicted Energy Assessment

Flat 1	Dwelling type:	Mid floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	62.82 m²
BS5 0EF		

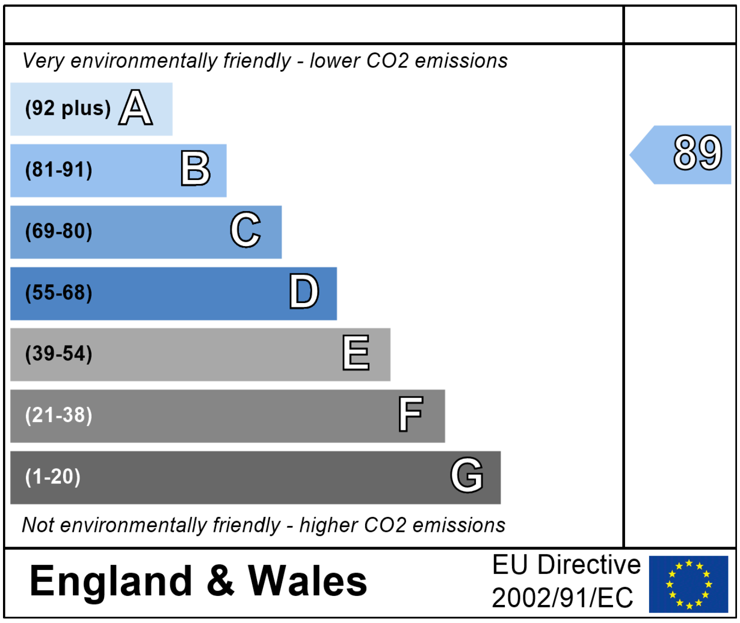
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1\ldots12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.72	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.59	19.73	19.98	20.33	20.65	20.89	20.97	20.96	20.77	20.35	19.91	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.58	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.75	19	19.35	19.66	19.86	19.91	19.91	19.78	19.38	18.94	18.6	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.77	0.59	0.65	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.95	376.03	420.37	460.46	460.15	381.55	277.55	285.13	354.43	346.28	322.04	318.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.13	1103.74	997.78	831.86	641.8	434.05	288.36	302.23	465.84	702.92	939.19	1138.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	600.54	489.02	429.59	267.41	135.15	0	0	0	0	265.33	444.35	610.41	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3241.79	(98)
Space heating requirement in kWh/m²/year	51.6	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.11	557.44	571.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.8	0.87	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	563.94	487.65	482.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	66.5	104.47	81.58	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	252.55	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	16.63	26.12	20.39	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	63.14	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.01	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	52.61	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.79	20.03	20.37	20.69	20.9	20.98	20.96	20.8	20.39	19.96	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.84	19.09	19.43	19.73	19.91	19.95	19.95	19.83	19.45	19.02	18.69	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.57	0.63	0.88	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.98	376.05	420.32	459.89	457.56	375.32	270.37	278.53	351.77	346.11	322.06	318.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1104.52	1067.38	964.98	804.41	620.66	419.54	278.85	292.27	450.67	679.88	908.08	1101.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.54	464.57	405.23	248.06	121.35	0	0	0	0	248.33	421.93	582.23	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3064.24 (98)

Space heating requirement in kWh/m²/year 48.78 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	680.63	535.82	549.37	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	556.93	478.18	474.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	71.55	111.51	87.45	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 270.51 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	17.89	27.88	21.86	0	0	0	0

Total = Sum(107)$_{6...8}$ = 67.63 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.08 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 49.85 (109)

Target Fabric Energy Efficiency (TFEE) 57.33 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1...12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22	

Average = Sum(40)$_{1\ldots12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	
Total = Sum(44)$_{1\ldots12}$ =												997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	
Total = Sum(45)$_{1\ldots12}$ =												1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 2.3 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 1.24 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09	

Output from water heater (annual)$_{1...12}$ 2035.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.5	84.06	90.1	83.29	83.45	77.19	76.63	80.65	79.43	86.25	88.03	93.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	44.54	39.56	32.17	24.36	18.21	15.37	16.61	21.59	28.98	36.79	42.94	45.78	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	268.66	271.44	264.42	249.46	230.58	212.84	200.99	198.2	205.22	220.18	239.06	256.8	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	127.02	125.1	121.11	115.69	112.17	107.21	103	108.4	110.31	115.93	122.26	125.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	533.84	529.72	511.32	483.13	454.58	429.05	414.22	421.81	438.14	466.52	497.88	521.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	579.03	618.14	656.93	695.49	714.84	695.47	667.86	639.68	607.49	571.43	554.24	558.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.92	0.82	0.65	0.49	0.53	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.07	20.29	20.59	20.83	20.96	20.99	20.99	20.91	20.62	20.23	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.95	0.9	0.77	0.56	0.37	0.41	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	18.71	19.03	19.44	19.75	19.89	19.92	19.92	19.85	19.5	18.96	18.5	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.37	19.64	20	20.27	20.41	20.44	20.44	20.37	20.04	19.58	19.19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.37	19.64	20	20.27	20.41	20.44	20.44	20.37	20.04	19.58	19.19	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.43	0.47	0.71	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	567.97	601.09	624.98	624.51	563.19	419.55	286.53	299.48	433.03	518.69	536.33	549.29	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1151.74	1114.75	1010.62	845.08	651.52	437.89	289.36	303.79	473.82	717.66	951.94	1147.69	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	434.33	345.18	286.91	158.8	65.72	0	0	0	0	148.03	299.24	445.21	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2183.43	(98)
Space heating requirement in kWh/m²/year	34.76	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	434.33	345.18	286.91	158.8	65.72	0	0	0	0	148.03	299.24	445.21		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	173.8	138.13	114.81	63.55	26.3	0	0	0	0	59.24	119.74	178.16		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													873.72	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	197.37	174.39	184.15	166.47	164.14	148.12	143.63	155.71	154.84	172.55	180.71	193.09		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	112.72	99.59	105.17	95.07	93.74	84.59	82.03	88.92	88.43	98.54	103.2	110.27		
Total = Sum(219a)$_{1...12}$ =													1162.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			873.72	
Water heating fuel used			1162.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			314.64	(232)
Electricity generated by PVs			-666.19	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	115.24	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	153.31	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	41.5	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	314.01	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.22	(257)
SAP rating (Section 12)		82.94	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	453.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	603.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1056.69	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Energy saving/generation technologies Item 1		0.519	=	-345.75	(269)
Total CO2, kg/year		sum of (265)…(271) =		889.8	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.16	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2682.33	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3568.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6250.54	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)

Electricity for lighting	(232) x	0	=	965.93	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-2045.21	(269)
'Total Primary Energy	sum of (265)…(271) =			5263.36	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			83.78	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - ASHP + PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17		
											Average = Sum(40)$_{1...12}$ /12=		1.17	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	2.06	(42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)		
if TFA £ 13.9, N = 1		
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.13	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44		
											Total = Sum(44)$_{1...12}$ =		997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33		
											Total = Sum(45)$_{1...12}$ =		1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		150	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		1.7	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.92	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.92	(55)
Water storage loss calculated for each month	((56)m = (55) × (41)m		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07	

Output from water heater (annual)$_{1...12}$ 1917.21 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.49	76.83	82.09	75.54	75.44	69.44	68.62	72.63	71.67	78.23	80.27	85.06	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	116.24	114.32	110.34	104.92	101.4	96.44	92.23	97.62	99.54	105.15	111.49	114.33	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	370.96	368.92	357.27	338.7	320.07	302.09	290.43	295.96	305.53	324.29	345.74	361.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	416.16	457.33	502.88	551.06	580.33	568.51	544.08	513.83	474.88	429.21	402.09	398.77	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.74	0.57	0.62	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.77	19.9	20.14	20.47	20.76	20.94	20.99	20.98	20.86	20.49	20.08	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.85	0.65	0.44	0.49	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.5	18.85	19.32	19.71	19.91	19.95	19.95	19.84	19.36	18.76	18.28	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.02	19.18	19.48	19.88	20.22	20.41	20.46	20.45	20.34	19.91	19.4	19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.02	19.18	19.48	19.88	20.22	20.41	20.46	20.45	20.34	19.91	19.4	19	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.5	0.55	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	413.92	453.14	492.79	521.46	499.42	391.91	274.36	285.15	386.19	412.13	398.03	397.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.65	1058.63	960.02	803.91	622.5	420.81	279.24	292.89	453.09	680.23	902.32	1089.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	505.72	406.89	347.62	203.37	91.57	0	0	0	0	199.47	363.09	515.42	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2633.14	(98)
Space heating requirement in kWh/m²/year	41.92	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	505.72	406.89	347.62	203.37	91.57	0	0	0	0	199.47	363.09	515.42		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	540.88	435.18	371.78	217.51	97.94	0	0	0	0	213.33	388.33	551.25		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2816.2	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	187.35	165.34	174.13	156.78	154.13	138.42	133.61	145.69	145.14	162.53	171.01	183.07		
Efficiency of water heater													79.8	(216)
(217)m=	87.33	87.12	86.62	85.51	83.48	79.8	79.8	79.8	79.8	85.36	86.77	87.43		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	214.52	189.77	201.02	183.34	184.63	173.46	167.43	182.57	181.88	190.41	197.07	209.4		
Total = Sum(219a)$_{1...12}$ =													2275.52	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2816.2	
Water heating fuel used			2275.52	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	608.3	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	491.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1099.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1302.03	(272)

TER =	30.36	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:36:45

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.82m²

Site Reference : Lawnwood House **Plot Reference:** Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	20.9 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	20.20 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.6 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	**OK**
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: West	7.53m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m^2)			Av. Height(m)			Volume(m^3)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.15	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	

Output from water heater (annual)$_{1...12}$ 1478.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.74	42.72	44.33	38.98	37.66	32.86	30.82	34.84	35.11	40.46	43.73	47.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	65.51	63.58	59.58	54.14	50.61	45.64	41.43	46.83	48.76	54.38	60.74	63.59	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	320.22	318.17	306.51	287.93	269.29	251.3	239.63	245.16	254.75	273.52	294.98	310.86	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	365.42	406.59	452.12	500.29	529.54	517.72	493.27	463.04	424.1	378.44	351.34	348.03	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.8	0.64	0.69	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.77	20.02	20.36	20.68	20.9	20.97	20.96	20.79	20.38	19.95	19.61	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.89	0.71	0.5	0.56	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.28	18.64	19.14	19.58	19.85	19.91	19.91	19.74	19.18	18.55	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.84	19	19.31	19.73	20.12	20.36	20.43	20.42	20.25	19.77	19.23	18.82	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.69	18.85	19.16	19.58	19.97	20.21	20.28	20.27	20.1	19.62	19.08	18.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.74	0.55	0.6	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.19	404.14	445.86	480.63	471.69	380.99	269.52	279	362.94	368.47	349.16	347.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1111.15	1075.11	973.49	813.42	628.06	422.59	277.14	291.07	453.79	685.12	914.01	1107.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.73	450.89	392.56	239.61	116.34	0	0	0	0	235.59	406.69	565.83	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2963.25	(98)
Space heating requirement in kWh/m²/year	47.17	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	555.73	450.89	392.56	239.61	116.34	0	0	0	0	235.59	406.69	565.83		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	614.07	498.22	433.76	264.76	128.55	0	0	0	0	260.32	449.39	625.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3274.31	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9		
Efficiency of water heater													87.3	(216)
(217)m=	89.8	89.76	89.65	89.4	88.87	87.3	87.3	87.3	87.3	89.36	89.68	89.83		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	167.25	146.79	152.72	135.03	131.47	117.18	110.27	124.15	124.92	140.2	150.55	162.43		
Total = Sum(219a)$_{1...12}$ =													1662.96	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3274.31	
Water heating fuel used			1662.96	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	707.25	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1066.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1268.67	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.2	(273)
EI rating (section 14)				84	(274)

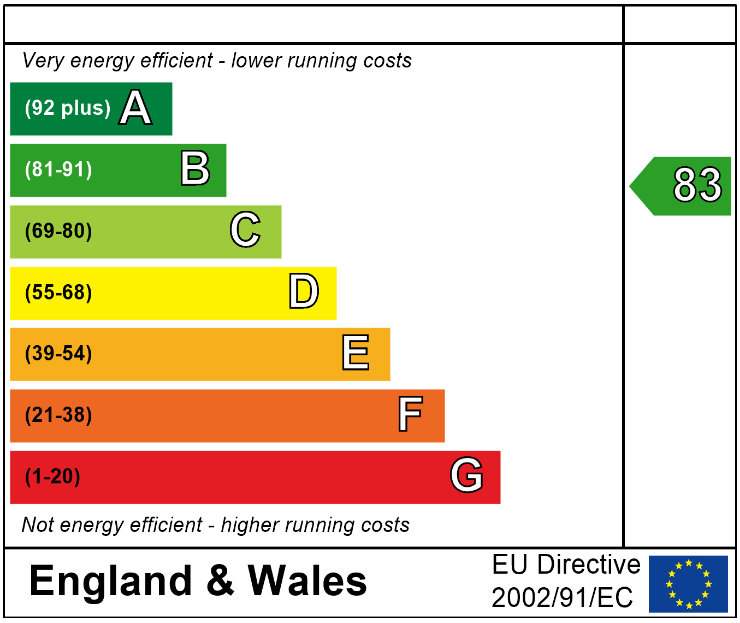
Predicted Energy Assessment

Flat 1	Dwelling type:	Mid floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	62.82 m²
BS5 0EF		

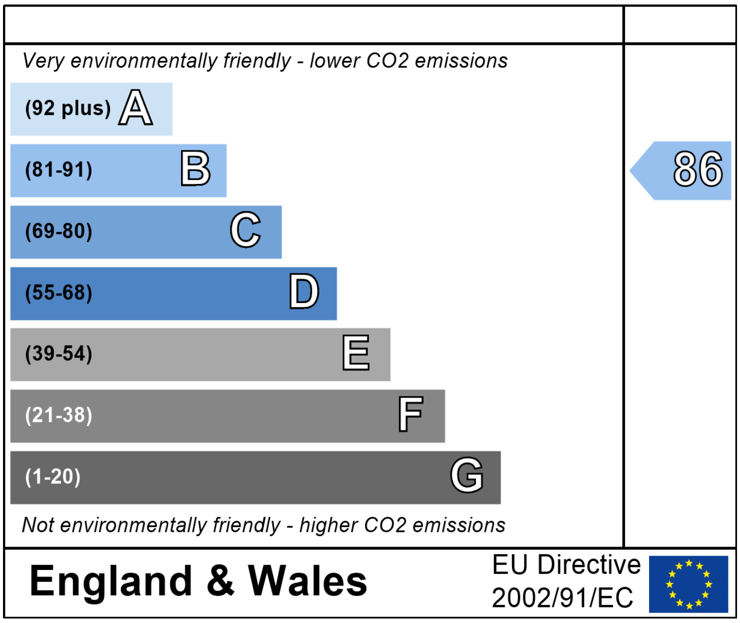
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1\ldots12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1...12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	
										Total = Sum(44)$_{1...12}$ =		997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	
										Total = Sum(45)$_{1...12}$ =		1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.72	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.59	19.73	19.98	20.33	20.65	20.89	20.97	20.96	20.77	20.35	19.91	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.58	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.75	19	19.35	19.66	19.86	19.91	19.91	19.78	19.38	18.94	18.6	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.77	0.59	0.65	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.95	376.03	420.37	460.46	460.15	381.55	277.55	285.13	354.43	346.28	322.04	318.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.13	1103.74	997.78	831.86	641.8	434.05	288.36	302.23	465.84	702.92	939.19	1138.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	600.54	489.02	429.59	267.41	135.15	0	0	0	0	265.33	444.35	610.41	(98)

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	3241.79	(98)
Space heating requirement in kWh/m²/year	51.6	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.11	557.44	571.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.8	0.87	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	563.94	487.65	482.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	66.5	104.47	81.58	0	0	0	0

	Total = $Sum(104)_{6...8}$ =	252.55	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	16.63	26.12	20.39	0	0	0	0

	Total = $Sum(107)_{6...8}$ =	63.14	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.01	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	52.61	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.74	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6136.17	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		17.48	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	46.22	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1\ldots12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1\ldots12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1\ldots12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.79	20.03	20.37	20.69	20.9	20.98	20.96	20.8	20.39	19.96	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.84	19.09	19.43	19.73	19.91	19.95	19.95	19.83	19.45	19.02	18.69	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.57	0.63	0.88	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.98	376.05	420.32	459.89	457.56	375.32	270.37	278.53	351.77	346.11	322.06	318.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1104.52	1067.38	964.98	804.41	620.66	419.54	278.85	292.27	450.67	679.88	908.08	1101.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.54	464.57	405.23	248.06	121.35	0	0	0	0	248.33	421.93	582.23	

Total per year (kWh/year) = $\mathrm{Sum}(98)_{1...5,9...12}$ = 3064.24 (98)

Space heating requirement in kWh/m²/year 48.78 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	680.63	535.82	549.37	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	556.93	478.18	474.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	71.55	111.51	87.45	0	0	0	0	

Total = $\mathrm{Sum}(104)_{6...8}$ = 270.51 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $\mathrm{Sum}(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	17.89	27.88	21.86	0	0	0	0

Total = $\mathrm{Sum}(107)_{6...8}$ = 67.63 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.08 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 49.85 (109)

Target Fabric Energy Efficiency (TFEE) 57.33 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22		
										Average = Sum(40)$_{1…12}$ /12=			1.21	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44		
										Total = Sum(44)$_{1…12}$ =			997.54	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33		
										Total = Sum(45)$_{1…12}$ =			1307.93	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.15	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	

Output from water heater (annual)$_{1...12}$ 1478.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.74	42.72	44.33	38.98	37.66	32.86	30.82	34.84	35.11	40.46	43.73	47.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	44.54	39.56	32.17	24.36	18.21	15.37	16.61	21.59	28.98	36.79	42.94	45.78	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	268.66	271.44	264.42	249.46	230.58	212.84	200.99	198.2	205.22	220.18	239.06	256.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	65.51	63.58	59.58	54.14	50.61	45.64	41.43	46.83	48.76	54.38	60.74	63.59	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	472.32	468.2	449.79	421.58	393.03	367.48	352.64	360.25	376.58	404.98	436.36	459.79	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	517.52	556.62	595.4	633.95	653.28	633.9	606.29	578.12	545.93	509.89	492.72	496.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.86	0.7	0.53	0.58	0.81	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.98	20.21	20.52	20.79	20.94	20.99	20.98	20.88	20.55	20.15	19.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.81	0.61	0.41	0.45	0.73	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.4	18.59	18.92	19.36	19.71	19.88	19.92	19.92	19.83	19.41	18.84	18.37	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.27	19.55	19.93	20.23	20.4	20.44	20.44	20.34	19.97	19.48	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.96	19.12	19.4	19.78	20.08	20.25	20.29	20.29	20.19	19.82	19.33	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.92	0.82	0.64	0.45	0.5	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	510.71	545.59	573.53	581.94	534.19	403.3	274.44	286.89	410.34	474.32	481.68	491.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.01	1095.31	991.83	827.97	636.9	425.63	277.86	292.21	460.4	700.28	932.8	1128.03	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	462.24	369.41	311.22	177.14	76.41	0	0	0	0	168.11	324.81	473.6	(98)

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2362.94	(98)
Space heating requirement in kWh/m²/year	37.61	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	462.24	369.41	311.22	177.14	76.41	0	0	0	0	168.11	324.81	473.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	510.77	408.19	343.88	195.74	84.43	0	0	0	0	185.75	358.91	523.31		(211)
Total (kWh/year) = $Sum(211)_{1...5,10....12}$ =													2610.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) = $Sum(215)_{1...5,10....12}$ =													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9		
Efficiency of water heater													87.3	(216)
(217)m=	89.69	89.64	89.5	89.18	88.54	87.3	87.3	87.3	87.3	89.11	89.54	89.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	167.45	146.99	152.98	135.37	131.96	117.18	110.27	124.15	124.92	140.6	150.79	162.61		
Total = $Sum(219a)_{1...12}$ =													1665.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2610.98	
Water heating fuel used			1665.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	90.86	(240)

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Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	57.95	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	41.5	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	320.21	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.25	(257)
SAP rating (Section 12)		82.6	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	563.97	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			923.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1125.89	(272)
CO2 emissions per m²		(272) ÷ (4) =		17.92	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3185.4	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2031.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5217.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	965.93	(268)
'Total Primary Energy		sum of (265)…(271) =		6413.22	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		102.09	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - Baseline

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.6	40.56	43.21	40.17	39.82	36.9	38.13	39.82	40.17	43.21	43.45	46.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92	

Output from water heater (annual)$_{1...12}$ 1806.57 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	56.74	49.57	51.5	45.52	44	38.6	36.75	41.19	41.65	47.64	51.07	55.32	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	76.26	73.77	69.21	63.22	59.13	53.61	49.4	55.36	57.85	64.03	70.94	74.35	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	330.98	328.36	316.14	297.01	277.81	259.26	247.6	253.69	263.84	283.17	305.18	321.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

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West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.18	416.78	461.75	509.37	538.07	525.68	501.24	471.57	433.19	388.08	361.54	358.79	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.71	19.84	20.09	20.42	20.72	20.92	20.98	20.97	20.83	20.44	20.02	19.69	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.41	18.77	19.25	19.66	19.9	19.95	19.95	19.81	19.28	18.67	18.19	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.11	19.41	19.82	20.18	20.4	20.45	20.45	20.3	19.84	19.33	18.92	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.11	19.41	19.82	20.18	20.4	20.45	20.45	20.3	19.84	19.33	18.92	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.73	0.54	0.6	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.84	414.15	455.04	488.28	476.5	382.85	272.24	281.8	368	377.24	359.16	357.78	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1088.28	1053.25	954.79	799.35	619.45	419.7	278.98	292.49	450.75	675.45	897.01	1084.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	530.8	429.48	371.82	223.96	106.36	0	0	0	0	221.87	387.25	540.63	(98)

TER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2812.16 (98)
Space heating requirement in kWh/m²/year	44.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	530.8	429.48	371.82	223.96	106.36	0	0	0	0	221.87	387.25	540.63		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	568.3	459.83	398.09	239.79	113.87	0	0	0	0	237.55	414.62	578.83		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3010.88	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92		
Efficiency of water heater													80.3	(216)
(217)m=	87.58	87.43	87.03	86.11	84.33	80.3	80.3	80.3	80.3	85.97	87.13	87.67		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	208.03	182.05	190.28	170.56	168.62	155.97	149.43	166.58	168.42	179.13	188.66	202.95		
Total = Sum(219a)$_{1...12}$ =													2130.66	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3010.88	
Water heating fuel used			2130.66	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	650.35	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	460.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1110.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1312.8	(272)

TER =	20.9	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:36:15

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: $62.82m^2$

Site Reference : Lawnwood House **Plot Reference:** Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	20.9 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.16 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	52.6 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: West	7.53m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = $Sum(40)_{1...12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = $Sum(44)_{1...12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = $Sum(45)_{1...12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.15	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	

Output from water heater (annual)$_{1...12}$ 1478.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.74	42.72	44.33	38.98	37.66	32.86	30.82	34.84	35.11	40.46	43.73	47.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	65.51	63.58	59.58	54.14	50.61	45.64	41.43	46.83	48.76	54.38	60.74	63.59	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	320.22	318.17	306.51	287.93	269.29	251.3	239.63	245.16	254.75	273.52	294.98	310.86	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	365.42	406.59	452.12	500.29	529.54	517.72	493.27	463.04	424.1	378.44	351.34	348.03	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.8	0.64	0.69	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.77	20.02	20.36	20.68	20.9	20.97	20.96	20.79	20.38	19.95	19.61	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.89	0.71	0.5	0.56	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.28	18.64	19.14	19.58	19.85	19.91	19.91	19.74	19.18	18.55	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.84	19	19.31	19.73	20.12	20.36	20.43	20.42	20.25	19.77	19.23	18.82	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.69	18.85	19.16	19.58	19.97	20.21	20.28	20.27	20.1	19.62	19.08	18.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.74	0.55	0.6	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.19	404.14	445.86	480.63	471.69	380.99	269.52	279	362.94	368.47	349.16	347.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1111.15	1075.11	973.49	813.42	628.06	422.59	277.14	291.07	453.79	685.12	914.01	1107.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.73	450.89	392.56	239.61	116.34	0	0	0	0	235.59	406.69	565.83	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2963.25	(98)
Space heating requirement in kWh/m²/year	47.17	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	555.73	450.89	392.56	239.61	116.34	0	0	0	0	235.59	406.69	565.83		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	614.07	498.22	433.76	264.76	128.55	0	0	0	0	260.32	449.39	625.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3274.31	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9		
Efficiency of water heater													87.3	(216)
(217)m=	89.8	89.76	89.65	89.4	88.87	87.3	87.3	87.3	87.3	89.36	89.68	89.83		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	167.25	146.79	152.72	135.03	131.47	117.18	110.27	124.15	124.92	140.2	150.55	162.43		
Total = Sum(219a)$_{1...12}$ =													1662.96	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3274.31	
Water heating fuel used			1662.96	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)
Electricity generated by PVs			-488.24	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	707.25	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1066.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Energy saving/generation technologies Item 1		0.519	=	-253.39	(269)
Total CO2, kg/year		sum of (265)…(271) =		1015.28	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.16	(273)
EI rating (section 14)				87	(274)

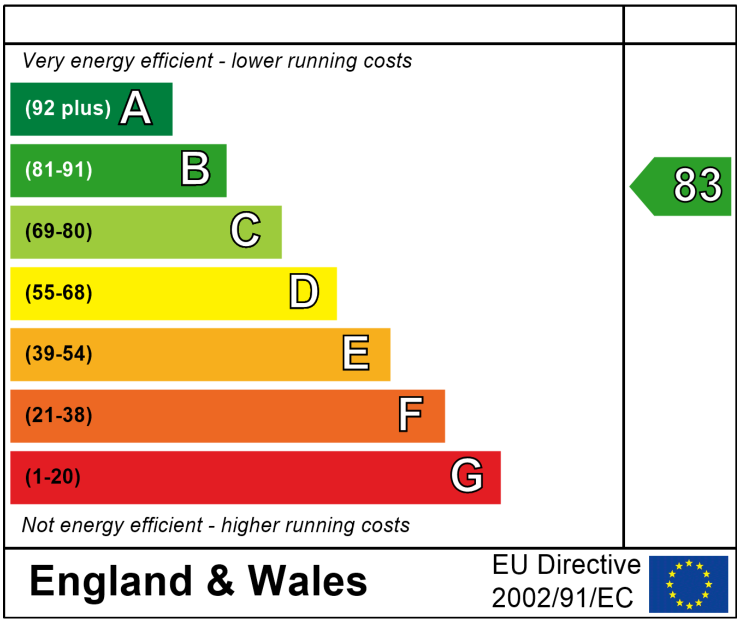
Predicted Energy Assessment

Flat 1	Dwelling type:	Mid floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	62.82 m²
BS5 0EF		

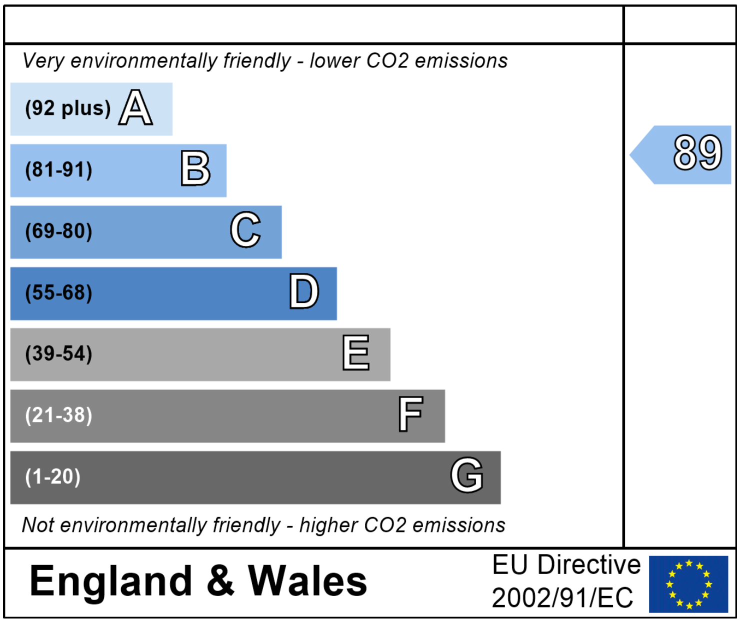
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) — (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) — ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K — Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 76.13 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22	

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

DFEE WorkSheet: New dwelling design stage

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.72	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.59	19.73	19.98	20.33	20.65	20.89	20.97	20.96	20.77	20.35	19.91	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.58	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.75	19	19.35	19.66	19.86	19.91	19.91	19.78	19.38	18.94	18.6	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.23	19.48	19.83	20.15	20.36	20.43	20.42	20.26	19.85	19.41	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	1	0.99	0.97	0.91	0.77	0.59	0.65	0.89	0.98	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	334.95	376.03	420.37	460.46	460.15	381.55	277.55	285.13	354.43	346.28	322.04	318.44	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1142.13	1103.74	997.78	831.86	641.8	434.05	288.36	302.23	465.84	702.92	939.19	1138.88	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	600.54	489.02	429.59	267.41	135.15	0	0	0	0	265.33	444.35	610.41	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3241.79 | (98)

Space heating requirement in kWh/m²/year | 51.6 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.11	557.44	571.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.8	0.87	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	563.94	487.65	482.25	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	66.5	104.47	81.58	0	0	0	0

Total = Sum(104)$_{6...8}$ = | 252.55 | (104)

Cooled fraction — f C = cooled area ÷ (4) = | 1 | (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = | 0 | (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	16.63	26.12	20.39	0	0	0	0

Total = Sum(107)$_{6...8}$ = | 63.14 | (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 1.01 | (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = | 52.61 | (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.82	(1a)	x	2.3	(2a)	=	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44	
											Total = Sum(44)$_{1…12}$ =	997.54	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33	
											Total = Sum(45)$_{1…12}$ =	1307.93	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.26	100.81	104.03	90.69	87.02	75.09	69.59	79.85	80.8	94.17	102.79	111.63	

Output from water heater (annual)$_{1...12}$ 1111.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.82	25.2	26.01	22.67	21.76	18.77	17.4	19.96	20.2	23.54	25.7	27.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	38.73	37.5	34.96	31.49	29.24	26.07	23.38	26.83	28.06	31.64	35.69	37.51	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	290.45	289.1	278.89	262.28	244.92	228.73	218.59	222.16	231.05	247.78	266.94	281.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	335.65	377.51	424.49	474.64	505.17	495.15	472.23	440.04	400.4	352.69	323.3	318.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.79	20.03	20.37	20.69	20.9	20.98	20.96	20.8	20.39	19.96	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.72	0.51	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.84	19.09	19.43	19.73	19.91	19.95	19.95	19.83	19.45	19.02	18.69	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.3	19.55	19.89	20.19	20.39	20.45	20.44	20.3	19.91	19.48	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.57	0.63	0.88	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.98	376.05	420.32	459.89	457.56	375.32	270.37	278.53	351.77	346.11	322.06	318.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1104.52	1067.38	964.98	804.41	620.66	419.54	278.85	292.27	450.67	679.88	908.08	1101.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.54	464.57	405.23	248.06	121.35	0	0	0	0	248.33	421.93	582.23	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3064.24	(98)
Space heating requirement in kWh/m²/year	48.78	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	680.63	535.82	549.37	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	556.93	478.18	474.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	656.31	628.06	591.9	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	71.55	111.51	87.45	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	270.51	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	17.89	27.88	21.86	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	67.63	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.08	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	49.85	(109)
Target Fabric Energy Efficiency (TFEE)		57.33	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.5 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.14 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.21	77.05	76.88	76.13	75.99	75.33	75.33	75.21	75.58	75.99	76.27	76.57	

Average = Sum(39)$_{1…12}$ /12= 76.13 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.15	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9	

Output from water heater (annual)$_{1...12}$ 1478.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.74	42.72	44.33	38.98	37.66	32.86	30.82	34.84	35.11	40.46	43.73	47.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	123.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	44.54	39.56	32.17	24.36	18.21	15.37	16.61	21.59	28.98	36.79	42.94	45.78	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	268.66	271.44	264.42	249.46	230.58	212.84	200.99	198.2	205.22	220.18	239.06	256.8	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	49.42	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)
Water heating gains (Table 5)													
(72)m=	65.51	63.58	59.58	54.14	50.61	45.64	41.43	46.83	48.76	54.38	60.74	63.59	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	472.32	468.2	449.79	421.58	393.03	367.48	352.64	360.25	376.58	404.98	436.36	459.79	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	517.52	556.62	595.4	633.95	653.28	633.9	606.29	578.12	545.93	509.89	492.72	496.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.86	0.7	0.53	0.58	0.81	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.98	20.21	20.52	20.79	20.94	20.99	20.98	20.88	20.55	20.15	19.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.81	0.61	0.41	0.45	0.73	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.4	18.59	18.92	19.36	19.71	19.88	19.92	19.92	19.83	19.41	18.84	18.37	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.11	19.27	19.55	19.93	20.23	20.4	20.44	20.44	20.34	19.97	19.48	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.96	19.12	19.4	19.78	20.08	20.25	20.29	20.29	20.19	19.82	19.33	18.93	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.92	0.82	0.64	0.45	0.5	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	510.71	545.59	573.53	581.94	534.19	403.3	274.44	286.89	410.34	474.32	481.68	491.47	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.01	1095.31	991.83	827.97	636.9	425.63	277.86	292.21	460.4	700.28	932.8	1128.03	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	462.24	369.41	311.22	177.14	76.41	0	0	0	0	168.11	324.81	473.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2362.94	(98)
Space heating requirement in kWh/m²/year	37.61	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	462.24	369.41	311.22	177.14	76.41	0	0	0	0	168.11	324.81	473.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	510.77	408.19	343.88	195.74	84.43	0	0	0	0	185.75	358.91	523.31		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2610.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.19	131.76	136.91	120.72	116.84	102.3	96.27	108.38	109.05	125.29	135.01	145.9		
Efficiency of water heater													87.3	(216)
(217)m=	89.69	89.64	89.5	89.18	88.54	87.3	87.3	87.3	87.3	89.11	89.54	89.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	167.45	146.99	152.98	135.37	131.96	117.18	110.27	124.15	124.92	140.6	150.79	162.61		
Total = Sum(219a)$_{1...12}$ =													1665.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2610.98	
Water heating fuel used			1665.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)
Electricity generated by PVs			-488.24	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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Space heating - main system 1	(211) x	3.48	x 0.01 =	90.86	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	57.95	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	41.5	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	320.21	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.25	(257)
SAP rating (Section 12)		82.6	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	563.97	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	359.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			923.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Energy saving/generation technologies Item 1		0.519	=	-253.39	(269)
Total CO2, kg/year		sum of (265)…(271) =		872.5	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.89	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3185.4	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2031.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5217.04	(265)

Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	965.93	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1498.89	(269)
'Total Primary Energy			sum of (265)…(271) =		4914.34	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		78.23	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 1 - PV

Address : Flat 1, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.82	(1a) x	2.3	(2a) =	144.49	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.82	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.49	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.31	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			7.53	x1/[1/(1.4)+ 0.04]		=	9.98			(27)
Floor			62.82	x	0.13	=	8.166599			(28)
Walls	54.26	9.73	44.53	x	0.18	=	8.02			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			119.96							(31)
Party wall			21.85	x	0	=	0			(32)
Party ceiling			59.94							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6136.17 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.06	27.9	27.74	26.98	26.84	26.19	26.19	26.06	26.44	26.84	27.13	27.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	74.29	74.12	73.96	73.21	73.07	72.41	72.41	72.29	72.66	73.07	73.35	73.65	

Average = Sum(39)$_{1…12}$ /12= 73.21 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.06 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.13 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.44	88.12	84.79	81.47	78.14	74.82	74.82	78.14	81.47	84.79	88.12	91.44

Total = Sum(44)$_{1…12}$ = 997.54 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	135.6	118.6	122.39	106.7	102.38	88.35	81.87	93.94	95.06	110.79	120.93	131.33

Total = Sum(45)$_{1…12}$ = 1307.93 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.34	17.79	18.36	16	15.36	13.25	12.28	14.09	14.26	16.62	18.14	19.7	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.6	40.56	43.21	40.17	39.82	36.9	38.13	39.82	40.17	43.21	43.45	46.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92	

Output from water heater (annual)$_{1...12}$ 1806.57 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	56.74	49.57	51.5	45.52	44	38.6	36.75	41.19	41.65	47.64	51.07	55.32	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.82	15.82	12.87	9.74	7.28	6.15	6.64	8.64	11.59	14.72	17.18	18.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	180	181.87	177.16	167.14	154.49	142.6	134.66	132.79	137.5	147.52	160.17	172.06	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	-82.41	(71)

Water heating gains (Table 5)

(72)m=	76.26	73.77	69.21	63.22	59.13	53.61	49.4	55.36	57.85	64.03	70.94	74.35	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	330.98	328.36	316.14	297.01	277.81	259.26	247.6	253.69	263.84	283.17	305.18	321.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	7.53	x	19.64	x	0.63	x	0.7	=	45.2	(80)
West	0.9x	0.77	x	7.53	x	38.42	x	0.63	x	0.7	=	88.42	(80)
West	0.9x	0.77	x	7.53	x	63.27	x	0.63	x	0.7	=	145.61	(80)
West	0.9x	0.77	x	7.53	x	92.28	x	0.63	x	0.7	=	212.36	(80)
West	0.9x	0.77	x	7.53	x	113.09	x	0.63	x	0.7	=	260.26	(80)

West	0.9x	0.77	x	7.53	x	115.77	x	0.63	x	0.7	=	266.42	(80)
West	0.9x	0.77	x	7.53	x	110.22	x	0.63	x	0.7	=	253.64	(80)
West	0.9x	0.77	x	7.53	x	94.68	x	0.63	x	0.7	=	217.87	(80)
West	0.9x	0.77	x	7.53	x	73.59	x	0.63	x	0.7	=	169.35	(80)
West	0.9x	0.77	x	7.53	x	45.59	x	0.63	x	0.7	=	104.91	(80)
West	0.9x	0.77	x	7.53	x	24.49	x	0.63	x	0.7	=	56.36	(80)
West	0.9x	0.77	x	7.53	x	16.15	x	0.63	x	0.7	=	37.17	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.2	88.42	145.61	212.36	260.26	266.42	253.64	217.87	169.35	104.91	56.36	37.17	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.18	416.78	461.75	509.37	538.07	525.68	501.24	471.57	433.19	388.08	361.54	358.79	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.71	19.84	20.09	20.42	20.72	20.92	20.98	20.97	20.83	20.44	20.02	19.69	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.41	18.77	19.25	19.66	19.9	19.95	19.95	19.81	19.28	18.67	18.19	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.11	19.41	19.82	20.18	20.4	20.45	20.45	20.3	19.84	19.33	18.92	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.11	19.41	19.82	20.18	20.4	20.45	20.45	20.3	19.84	19.33	18.92	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.73	0.54	0.6	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.84	414.15	455.04	488.28	476.5	382.85	272.24	281.8	368	377.24	359.16	357.78	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1088.28	1053.25	954.79	799.35	619.45	419.7	278.98	292.49	450.75	675.45	897.01	1084.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	530.8	429.48	371.82	223.96	106.36	0	0	0	0	221.87	387.25	540.63	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2812.16	(98)
Space heating requirement in kWh/m²/year	44.77	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	530.8	429.48	371.82	223.96	106.36	0	0	0	0	221.87	387.25	540.63		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	568.3	459.83	398.09	239.79	113.87	0	0	0	0	237.55	414.62	578.83		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3010.88	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	182.2	159.16	165.59	146.87	142.2	125.24	119.99	133.76	135.24	154	164.39	177.92		
Efficiency of water heater													80.3	(216)
(217)m=	87.58	87.43	87.03	86.11	84.33	80.3	80.3	80.3	80.3	85.97	87.13	87.67		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	208.03	182.05	190.28	170.56	168.62	155.97	149.43	166.58	168.42	179.13	188.66	202.95		
Total = Sum(219a)$_{1...12}$ =													2130.66	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3010.88	
Water heating fuel used			2130.66	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			314.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	650.35	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	460.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1110.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1312.8	(272)

TER =	20.9	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:54

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.02m²

Site Reference : Lawnwood House **Plot Reference:** Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity		
Fuel factor: 1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	21.73 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.08 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.45 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: West	$5.65m^2$
Windows facing: North	$8.79m^2$
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4	

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	

Output from water heater (annual)$_{1...12}$ 2026.93 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.22	83.82	89.85	83.07	83.24	77.01	76.46	80.45	79.23	86.02	87.78	92.8	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	126.64	124.73	120.76	115.38	111.88	106.96	102.77	108.13	110.04	115.61	121.91	124.73	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	377.09	375.25	364	345.92	327.72	310.03	298.43	303.72	312.92	331.19	352.18	367.77	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	439.57	496.18	566.02	654.26	723.71	724.8	689.35	626.36	551.51	474.89	429.71	419.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.68	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.68	19.98	20.39	20.73	20.93	20.98	20.97	20.82	20.37	19.88	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.39	0.45	0.76	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.06	18.49	19.07	19.52	19.74	19.78	19.77	19.64	19.06	18.35	17.79	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.59	18.79	19.16	19.66	20.07	20.27	20.32	20.31	20.17	19.65	19.04	18.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	18.59	18.79	19.16	19.66	20.07	20.27	20.32	20.31	20.17	19.65	19.04	18.56	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.81	0.62	0.45	0.52	0.79	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	436.31	489.77	549.81	603.85	586.38	452.79	311.38	322.99	434.49	451.49	423.96	416.91	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.13	1208.85	1099.77	926.67	719.3	483.92	317.26	333.22	519.05	777.92	1029.78	1242.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	602.51	483.22	409.17	232.43	98.89	0	0	0	0	242.87	436.19	614.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3119.82 (98)

Space heating requirement in kWh/m²/year 50.3 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	602.51	483.22	409.17	232.43	98.89	0	0	0	0	242.87	436.19	614.53	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	241.1	193.37	163.74	93.01	39.57	0	0	0	0	97.19	174.55	245.91	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1248.43 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	112.23	99.17	104.73	94.69	93.38	84.27	81.73	88.59	88.09	98.15	102.77	109.8	

Total = Sum(219a)$_{1...12}$ = 1157.59 (219)

Annual totals	kWh/year	kWh/year
Space heating fuel used, main system 1		1248.43

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Water heating fuel used			1157.59	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			280.27	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	647.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	250.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =			897.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Total CO2, kg/year		sum of (265)…(271) =		1059	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.08	(273)
EI rating (section 14)				87	(274)

Predicted Energy Assessment

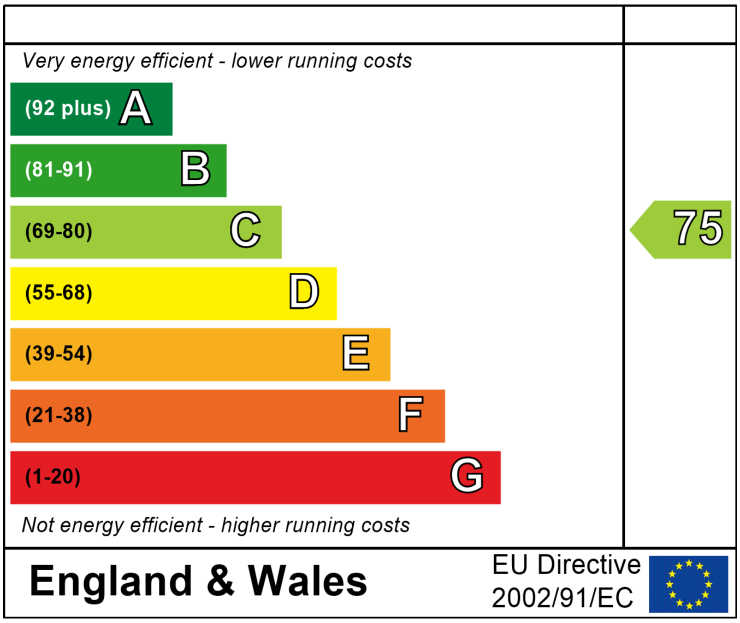
Flat 2
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Mid floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	62.02 m²

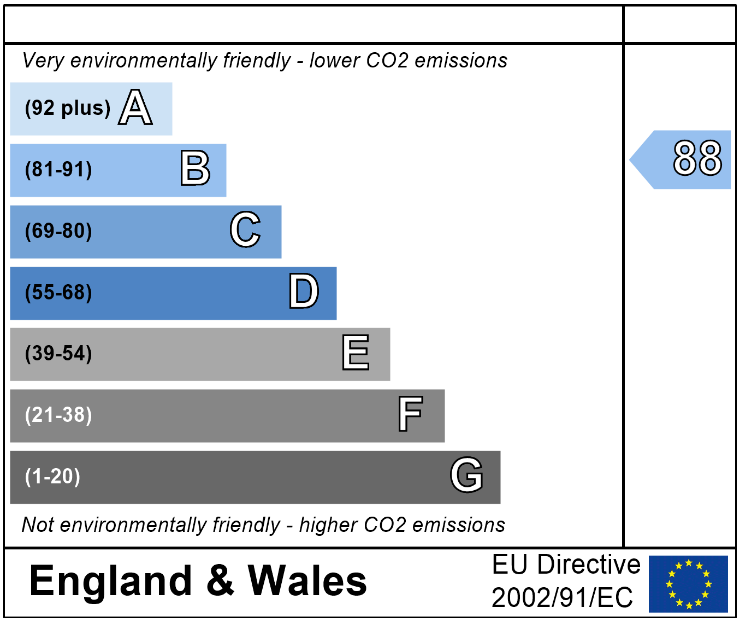
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = $Sum(40)_{1...12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = $Sum(44)_{1...12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = $Sum(45)_{1...12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ | 1104.75 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	285.94	284.79	274.97	258.84	241.9	225.99	215.9	219.25	227.76	244.02	262.74	277.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	348.42	405.72	476.99	567.17	637.89	640.76	606.82	541.89	466.35	387.72	340.26	329.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.59	0.66	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.56	19.86	20.28	20.67	20.9	20.97	20.95	20.75	20.26	19.75	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.47	18.78	19.2	19.55	19.74	19.78	19.77	19.64	19.18	18.68	18.29	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.51	0.58	0.85	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.42	403.36	469.71	539.11	546.93	438.53	307.71	316.12	397.47	378.06	338.45	328.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1264.17	1223.61	1108.68	928.74	717.94	482.83	316.87	332.51	516.49	779.16	1040.27	1261.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	682.06	551.2	475.39	280.53	127.23	0	0	0	0	298.42	505.32	694.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3614.46 (98)

Space heating requirement in kWh/m²/year 58.28 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	801.91	631.29	647.43	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	661.54	561.75	549.54	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	824.92	783.75	709.04	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	117.63	165.17	118.67	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 401.47 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	29.41	41.29	29.67	0	0	0	0

Total = Sum(107)$_{6...8}$ = 100.37 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.62 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 59.9 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28

Average = $Sum(39)_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31	

Average = Sum(40)$_{1\ldots12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	
									Total = Sum(44)$_{1\ldots12}$ =			991.27	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	
									Total = Sum(45)$_{1\ldots12}$ =			1299.71	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.96	284.81	274.99	258.85	241.91	225.99	215.91	219.26	227.77	244.03	262.76	277.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

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North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.56	396.29	461.22	543.08	606.94	608.33	576.26	516.67	447.72	376.5	334.23	325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.58	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.49	19.65	19.93	20.33	20.69	20.91	20.98	20.96	20.77	20.31	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.65	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.46	18.61	18.9	19.3	19.63	19.81	19.84	19.84	19.71	19.28	18.81	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.95	0.86	0.69	0.51	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.68	394.23	454.86	518.11	523.61	418.4	293	301.67	382.78	367.72	332.6	324.35	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1198.12	1159.14	1049.69	878.34	678.75	456.65	300.45	315.23	489.13	738.04	985.53	1195.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	636.45	514.02	442.55	259.36	115.43	0	0	0	0	275.52	470.11	647.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3361.29 (98)

Space heating requirement in kWh/m²/year 54.2 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	752.42	592.33	607.41	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	631.25	534.31	524.8	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	787.03	748.04	679.58	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	112.16	159.01	115.15	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 386.32 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	28.04	39.75	28.79	0	0	0	0

Total = Sum(107)$_{6...8}$ = 96.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.56 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 55.75 (109)

Target Fabric Energy Efficiency (TFEE) 64.12 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1...12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1...12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1...12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	

Output from water heater (annual)$_{1...12}$ 2026.93 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.22	83.82	89.85	83.07	83.24	77.01	76.46	80.45	79.23	86.02	87.78	92.8	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	39.67	35.24	28.66	21.7	16.22	13.69	14.79	19.23	25.81	32.77	38.25	40.78	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	265.69	268.45	261.5	246.71	228.04	210.49	198.77	196.01	202.96	217.75	236.42	253.97	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	126.64	124.73	120.76	115.38	111.88	106.96	102.77	108.13	110.04	115.61	121.91	124.73	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	525.03	521.44	503.95	476.81	449.16	424.17	409.36	416.4	431.84	459.16	489.61	512.51	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	587.51	642.37	705.96	785.15	845.15	838.94	800.28	739.04	670.43	602.86	567.13	564.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.79	0.61	0.46	0.51	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.88	20.16	20.52	20.81	20.95	20.99	20.98	20.88	20.52	20.07	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.88	0.73	0.51	0.34	0.39	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.35	18.74	19.24	19.6	19.75	19.78	19.78	19.69	19.26	18.62	18.09	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	19.04	19.38	19.82	20.14	20.29	20.32	20.32	20.23	19.82	19.27	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.85	19.04	19.38	19.82	20.14	20.29	20.32	20.32	20.23	19.82	19.27	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.94	0.88	0.75	0.56	0.39	0.44	0.7	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	575.73	622.98	666.66	689.18	630.75	465.85	314.25	328.18	470.82	545.63	548.28	554.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1268.54	1230.32	1118.69	940.25	725.95	485.73	317.66	333.94	524.34	792.95	1049.69	1264.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	515.45	408.14	336.31	180.78	70.83	0	0	0	0	184	361.01	528.5	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2585.02 (98)

Space heating requirement in kWh/m²/year 41.68 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	515.45	408.14	336.31	180.78	70.83	0	0	0	0	184	361.01	528.5	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	206.26	163.32	134.58	72.34	28.34	0	0	0	0	73.63	144.46	211.49	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1034.42 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	112.23	99.17	104.73	94.69	93.38	84.27	81.73	88.59	88.09	98.15	102.77	109.8	

Total = Sum(219a)$_{1...12}$ = 1157.59 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1034.42

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Water heating fuel used		1157.59	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		280.27	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	13.19	x 0.01 =	136.44	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		13.19	x 0.01 =	152.69	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		13.19	x 0.01 =	36.97	(250)
Additional standing charges (Table 12)					120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	450.05	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.77	(257)
SAP rating (Section 12)		75.36	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	536.86	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	250.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				786.9	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	145.46	(268)
Total CO2, kg/year			sum of (265)…(271) =		947.93	(272)
CO2 emissions per m²			(272) ÷ (4) =		15.28	(273)
EI rating (section 14)					88	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	3175.67	(261)

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Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1412.26	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4587.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	860.42	(268)
'Total Primary Energy		sum of (265)…(271) =		5540.45	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		89.33	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28

Average = Sum(39)$_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1...12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	
											Total = Sum(44)$_{1...12}$ =	991.27	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	
											Total = Sum(45)$_{1...12}$ =	1299.71	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25	

Output from water heater (annual)$_{1...12}$ 1908.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.2	76.58	81.83	75.32	75.22	69.25	68.45	72.44	71.47	78	80.02	84.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	115.86	113.96	109.99	104.61	101.11	96.18	92	97.36	99.27	104.84	111.14	113.96	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	366.34	364.5	353.25	335.16	316.96	299.27	287.67	292.96	302.16	320.43	341.43	357.03	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	423.93	475.98	539.47	619.39	681.99	681.6	648.02	590.37	522.1	452.9	412.9	404.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.61	19.76	20.04	20.43	20.76	20.94	20.99	20.97	20.83	20.41	19.95	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.8	0.59	0.4	0.46	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.22	18.62	19.17	19.61	19.81	19.84	19.84	19.71	19.17	18.49	17.96	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.72	18.91	19.26	19.74	20.12	20.32	20.36	20.35	20.22	19.73	19.15	18.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.72	18.91	19.26	19.74	20.12	20.32	20.36	20.35	20.22	19.73	19.15	18.69	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.82	0.63	0.46	0.52	0.79	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.24	470.65	525.79	575.56	558.37	430.43	295.91	307.21	414.93	432.52	408.08	402.59	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1181.53	1145.48	1041.27	876.15	679.77	457.51	300.74	315.77	491.18	736.51	975.68	1178.03	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	565.66	453.49	383.52	216.43	90.32	0	0	0	0	226.17	408.68	576.93	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2921.18 (98)

Space heating requirement in kWh/m²/year 47.1 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	565.66	453.49	383.52	216.43	90.32	0	0	0	0	226.17	408.68	576.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	604.98	485.01	410.18	231.47	96.6	0	0	0	0	241.89	437.09	617.04		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3124.26	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25		
Efficiency of water heater													79.8	(216)
(217)m=	87.59	87.38	86.87	85.69	83.46	79.8	79.8	79.8	79.8	85.71	87.07	87.68		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	212.93	188.37	199.56	182.18	183.91	172.77	166.79	181.83	181.13	188.83	195.54	207.86		
Total = Sum(219a)$_{1...12}$ =													2261.68	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3124.26

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Water heating fuel used			2261.68	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	674.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	488.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1163.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.66	(268)
Total CO2, kg/year		sum of (265)…(271) =		1347.95	(272)

TER = 21.73 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:44

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.02m²

Site Reference : Lawnwood House **Plot Reference:** Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	21.73 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.57 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.45 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Heat pumps with radiators or underfloor heating - electric
Air source heat pump with flow temperature <= 35°C

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services		OK
Hot water controls:	Cylinderstat		OK
	Independent timer for DHW		OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.65m²	
Windows facing: North	8.79m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	36.72	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5465.14	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		22.72	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	59.44	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	
Total = Sum(44)$_{1…12}$ =												991.27	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	
Total = Sum(45)$_{1…12}$ =												1299.71	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 2.3 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 1.24 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	

Output from water heater (annual)$_{1...12}$ | 2026.93 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.22	83.82	89.85	83.07	83.24	77.01	76.46	80.45	79.23	86.02	87.78	92.8	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	126.64	124.73	120.76	115.38	111.88	106.96	102.77	108.13	110.04	115.61	121.91	124.73	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	377.09	375.25	364	345.92	327.72	310.03	298.43	303.72	312.92	331.19	352.18	367.77	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

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North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	439.57	496.18	566.02	654.26	723.71	724.8	689.35	626.36	551.51	474.89	429.71	419.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.68	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.68	19.98	20.39	20.73	20.93	20.98	20.97	20.82	20.37	19.88	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.8	0.58	0.39	0.45	0.76	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.06	18.49	19.07	19.52	19.74	19.78	19.77	19.64	19.06	18.35	17.79	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.59	18.79	19.16	19.66	20.07	20.27	20.32	20.31	20.17	19.65	19.04	18.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.59	18.79	19.16	19.66	20.07	20.27	20.32	20.31	20.17	19.65	19.04	18.56	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.81	0.62	0.45	0.52	0.79	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	436.31	489.77	549.81	603.85	586.38	452.79	311.38	322.99	434.49	451.49	423.96	416.91	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.13	1208.85	1099.77	926.67	719.3	483.92	317.26	333.22	519.05	777.92	1029.78	1242.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	602.51	483.22	409.17	232.43	98.89	0	0	0	0	242.87	436.19	614.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3119.82 (98)

Space heating requirement in kWh/m²/year 50.3 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	602.51	483.22	409.17	232.43	98.89	0	0	0	0	242.87	436.19	614.53	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	241.1	193.37	163.74	93.01	39.57	0	0	0	0	97.19	174.55	245.91	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1248.43 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26

Efficiency of water heater 175.1 (216)

(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	112.23	99.17	104.73	94.69	93.38	84.27	81.73	88.59	88.09	98.15	102.77	109.8

Total = Sum(219a)$_{1...12}$ = 1157.59 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1248.43

Water heating fuel used		1157.59	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		280.27	(232)
Electricity generated by PVs		-657.83	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	647.93	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	250.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				897.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	145.46	(268)
Energy saving/generation technologies Item 1			0.519	=	-341.41	(269)
Total CO2, kg/year			sum of (265)…(271) =		717.59	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		11.57	(273)
EI rating (section 14)					91	(274)

Predicted Energy Assessment

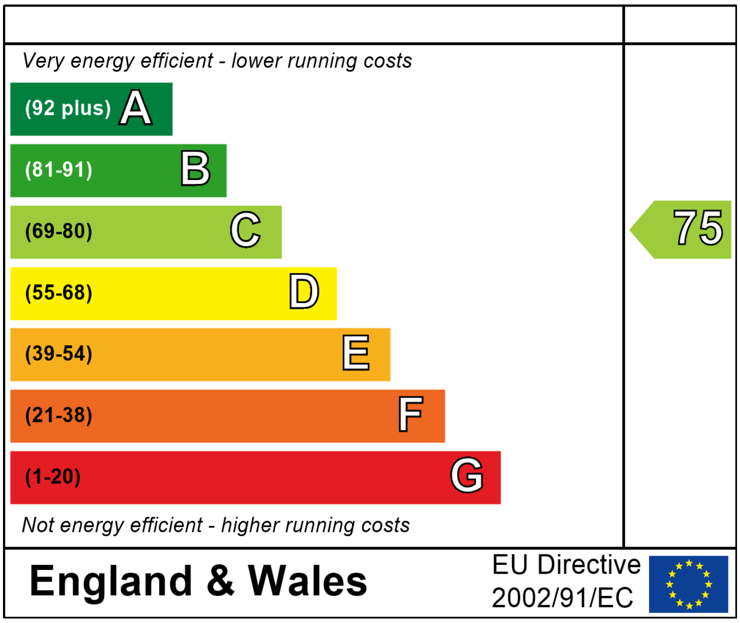
Flat 2
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type: Mid floor Flat
Date of assessment: 20 April 2020
Produced by: Benjamin Leech
Total floor area: 62.02 m²

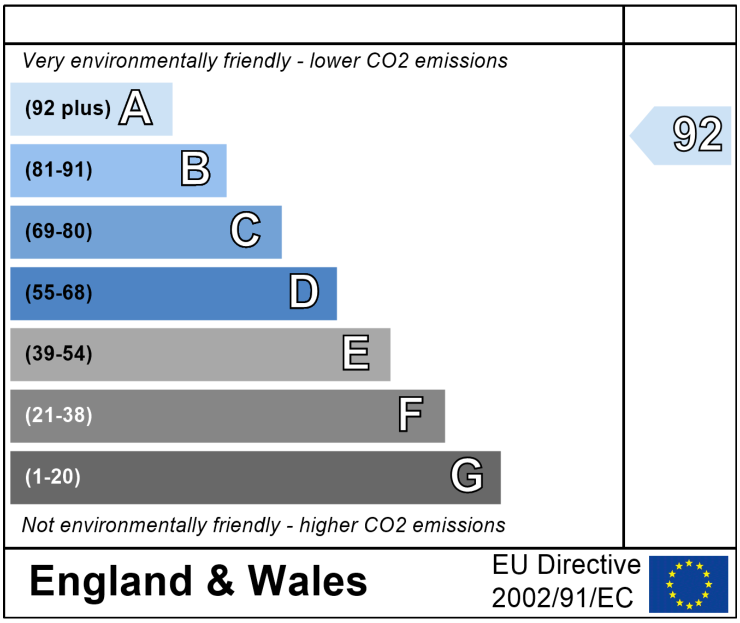
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	285.94	284.79	274.97	258.84	241.9	225.99	215.9	219.25	227.76	244.02	262.74	277.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

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North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	348.42	405.72	476.99	567.17	637.89	640.76	606.82	541.89	466.35	387.72	340.26	329.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.59	0.66	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.56	19.86	20.28	20.67	20.9	20.97	20.95	20.75	20.26	19.75	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.47	18.78	19.2	19.55	19.74	19.78	19.77	19.64	19.18	18.68	18.29	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.51	0.58	0.85	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.42	403.36	469.71	539.11	546.93	438.53	307.71	316.12	397.47	378.06	338.45	328.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1264.17	1223.61	1108.68	928.74	717.94	482.83	316.87	332.51	516.49	779.16	1040.27	1261.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	682.06	551.2	475.39	280.53	127.23	0	0	0	0	298.42	505.32	694.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3614.46 (98)

Space heating requirement in kWh/m²/year 58.28 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	801.91	631.29	647.43	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	661.54	561.75	549.54	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	824.92	783.75	709.04	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	117.63	165.17	118.67	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 401.47 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	29.41	41.29	29.67	0	0	0	0

Total = Sum(107)$_{6...8}$ = 100.37 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.62 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.9 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 80.84 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	285.96	284.81	274.99	258.85	241.91	225.99	215.91	219.26	227.77	244.03	262.76	277.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

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North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.56	396.29	461.22	543.08	606.94	608.33	576.26	516.67	447.72	376.5	334.23	325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.58	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.49	19.65	19.93	20.33	20.69	20.91	20.98	20.96	20.77	20.31	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.65	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.46	18.61	18.9	19.3	19.63	19.81	19.84	19.84	19.71	19.28	18.81	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.95	0.86	0.69	0.51	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.68	394.23	454.86	518.11	523.61	418.4	293	301.67	382.78	367.72	332.6	324.35	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1198.12	1159.14	1049.69	878.34	678.75	456.65	300.45	315.23	489.13	738.04	985.53	1195.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	636.45	514.02	442.55	259.36	115.43	0	0	0	0	275.52	470.11	647.85	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3361.29 (98)

Space heating requirement in kWh/m²/year 54.2 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	752.42	592.33	607.41	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	631.25	534.31	524.8	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	787.03	748.04	679.58	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	112.16	159.01	115.15	0	0	0	0	

Total = Sum(104)6...8 = 386.32 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)6...8 = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	28.04	39.75	28.79	0	0	0	0

Total = Sum(107)6...8 = 96.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.56 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 55.75 (109)

Target Fabric Energy Efficiency (TFEE) 64.12 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26	

Output from water heater (annual)$_{1...12}$ 2026.93 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.22	83.82	89.85	83.07	83.24	77.01	76.46	80.45	79.23	86.02	87.78	92.8	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	39.67	35.24	28.66	21.7	16.22	13.69	14.79	19.23	25.81	32.77	38.25	40.78	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	265.69	268.45	261.5	246.71	228.04	210.49	198.77	196.01	202.96	217.75	236.42	253.97	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	126.64	124.73	120.76	115.38	111.88	106.96	102.77	108.13	110.04	115.61	121.91	124.73	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	525.03	521.44	503.95	476.81	449.16	424.17	409.36	416.4	431.84	459.16	489.61	512.51	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	587.51	642.37	705.96	785.15	845.15	838.94	800.28	739.04	670.43	602.86	567.13	564.21	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.79	0.61	0.46	0.51	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.88	20.16	20.52	20.81	20.95	20.99	20.98	20.88	20.52	20.07	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.88	0.73	0.51	0.34	0.39	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.35	18.74	19.24	19.6	19.75	19.78	19.78	19.69	19.26	18.62	18.09	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	19.04	19.38	19.82	20.14	20.29	20.32	20.32	20.23	19.82	19.27	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.85	19.04	19.38	19.82	20.14	20.29	20.32	20.32	20.23	19.82	19.27	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.94	0.88	0.75	0.56	0.39	0.44	0.7	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	575.73	622.98	666.66	689.18	630.75	465.85	314.25	328.18	470.82	545.63	548.28	554.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1268.54	1230.32	1118.69	940.25	725.95	485.73	317.66	333.94	524.34	792.95	1049.69	1264.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	515.45	408.14	336.31	180.78	70.83	0	0	0	0	184	361.01	528.5	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2585.02 (98)

Space heating requirement in kWh/m²/year 41.68 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	515.45	408.14	336.31	180.78	70.83	0	0	0	0	184	361.01	528.5	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	206.26	163.32	134.58	72.34	28.34	0	0	0	0	73.63	144.46	211.49	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1034.42 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	196.52	173.64	183.38	165.8	163.5	147.56	143.12	155.12	154.24	171.86	179.95	192.26

Efficiency of water heater 175.1 (216)

(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	112.23	99.17	104.73	94.69	93.38	84.27	81.73	88.59	88.09	98.15	102.77	109.8

Total = Sum(219a)$_{1...12}$ = 1157.59 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1034.42

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Water heating fuel used			1157.59	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			280.27	(232)
Electricity generated by PVs			-657.83	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	136.44	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	152.69	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.97	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	450.05	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.77	(257)
SAP rating (Section 12)		75.36	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	536.86	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	250.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =			786.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-341.41	(269)
Total CO2, kg/year		sum of (265)…(271) =		606.52	(272)

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CO_2 emissions per m²		(272) ÷ (4) =	9.78	(273)
EI rating (section 14)			92	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	3175.67	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1412.26	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4587.93	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	860.42	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-2019.53	(269)
‘Total Primary Energy		sum of (265)…(271) =		3520.92	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		56.77	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - ASHP + PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28

Average = Sum(39)$_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31	

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.7 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0.92 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25	

Output from water heater (annual)$_{1...12}$ 1908.98 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.2	76.58	81.83	75.32	75.22	69.25	68.45	72.44	71.47	78	80.02	84.79	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	115.86	113.96	109.99	104.61	101.11	96.18	92	97.36	99.27	104.84	111.14	113.96	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	366.34	364.5	353.25	335.16	316.96	299.27	287.67	292.96	302.16	320.43	341.43	357.03	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

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North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	423.93	475.98	539.47	619.39	681.99	681.6	648.02	590.37	522.1	452.9	412.9	404.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.61	19.76	20.04	20.43	20.76	20.94	20.99	20.97	20.83	20.41	19.95	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.8	0.59	0.4	0.46	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.22	18.62	19.17	19.61	19.81	19.84	19.84	19.71	19.17	18.49	17.96	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.72	18.91	19.26	19.74	20.12	20.32	20.36	20.35	20.22	19.73	19.15	18.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.72	18.91	19.26	19.74	20.12	20.32	20.36	20.35	20.22	19.73	19.15	18.69	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.82	0.63	0.46	0.52	0.79	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.24	470.65	525.79	575.56	558.37	430.43	295.91	307.21	414.93	432.52	408.08	402.59	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1181.53	1145.48	1041.27	876.15	679.77	457.51	300.74	315.77	491.18	736.51	975.68	1178.03	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	565.66	453.49	383.52	216.43	90.32	0	0	0	0	226.17	408.68	576.93	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2921.18 (98)

Space heating requirement in kWh/m²/year 47.1 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	565.66	453.49	383.52	216.43	90.32	0	0	0	0	226.17	408.68	576.93	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	604.98	485.01	410.18	231.47	96.6	0	0	0	0	241.89	437.09	617.04	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3124.26 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	186.5	164.59	173.36	156.1	153.48	137.87	133.1	145.1	144.54	161.84	170.25	182.25	
Efficiency of water heater												79.8	(216)
(217)m=	87.59	87.38	86.87	85.69	83.46	79.8	79.8	79.8	79.8	85.71	87.07	87.68	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	212.93	188.37	199.56	182.18	183.91	172.77	166.79	181.83	181.13	188.83	195.54	207.86	

Total = Sum(219a)$_{1...12}$ = 2261.68 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3124.26

TER WorkSheet: New dwelling design stage

Water heating fuel used			2261.68	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	674.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	488.52	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1163.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.66	(268)
Total CO2, kg/year		sum of (265)…(271) =		1347.95	(272)

TER = 21.73 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:36:05

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.02m²

Site Reference : Lawnwood House **Plot Reference:** Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.87 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.45 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.45 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.65m²	
Windows facing: North	8.79m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.58	13.15	14.52	14.02	14.45	13.95	14.4	14.43	13.99	14.5	14.07	14.57	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	

Output from water heater (annual)$_{1...12}$ 1470.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.45	42.47	44.07	38.76	37.44	32.68	30.65	34.65	34.91	40.23	43.48	47.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	65.12	63.21	59.23	53.83	50.32	45.39	41.19	46.57	48.48	54.07	60.38	63.22	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	315.58	313.73	302.47	284.37	266.17	248.46	236.86	242.16	251.36	269.64	290.66	306.26	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	378.05	434.66	504.48	592.71	662.16	663.23	627.78	564.79	489.95	413.34	368.18	357.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.73	0.57	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.44	19.6	19.9	20.31	20.69	20.91	20.98	20.96	20.77	20.29	19.79	19.41	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.43	0.5	0.81	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.7	17.94	18.37	18.97	19.47	19.72	19.77	19.77	19.59	18.95	18.23	17.66	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.48	18.68	19.06	19.58	20.02	20.26	20.31	20.3	20.12	19.55	18.93	18.45	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.33	18.53	18.91	19.43	19.87	20.11	20.16	20.15	19.97	19.4	18.78	18.3	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.54	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	376.36	430.97	494.09	556.41	553.37	433.63	297.33	307.66	403.35	399.19	365.17	356.69	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1223.5	1186.4	1077.83	906.39	702.04	469.68	304.09	319.78	502.28	756.78	1007.52	1220.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	630.27	507.65	434.31	251.99	110.61	0	0	0	0	266.05	462.49	642.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3305.94 (98)

Space heating requirement in kWh/m²/year 53.3 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	630.27	507.65	434.31	251.99	110.61	0	0	0	0	266.05	462.49	642.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	696.43	560.94	479.9	278.44	122.23	0	0	0	0	293.98	511.04	710.03		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3652.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07		
Efficiency of water heater													87.3	(216)
(217)m=	89.87	89.82	89.72	89.44	88.83	87.3	87.3	87.3	87.3	89.45	89.76	89.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	166.17	145.85	151.75	134.21	130.8	116.55	109.68	123.47	124.23	139.27	149.56	161.38		
Total = Sum(219a)$_{1...12}$ =													1652.92	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3652.98

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Water heating fuel used			1652.92	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.27	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	789.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	357.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1146.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Total CO2, kg/year		sum of (265)…(271) =		1330.46	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.45	(273)
EI rating (section 14)				83	(274)

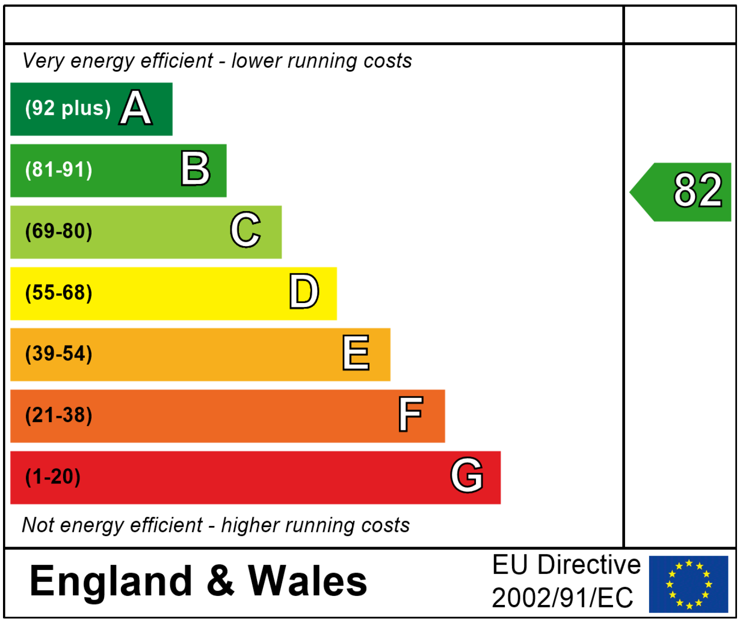
Predicted Energy Assessment

Flat 2 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Date of assessment: Produced by: Total floor area:	Mid floor Flat 20 April 2020 Benjamin Leech 62.02 m²

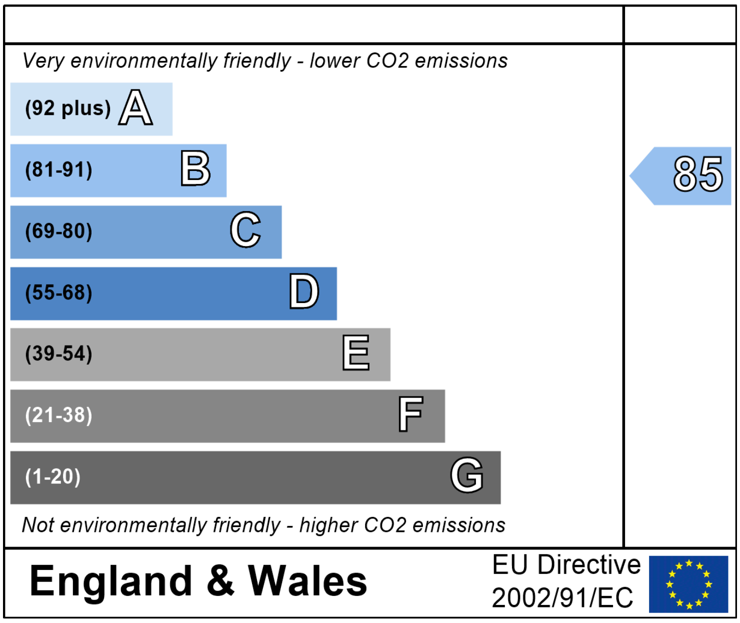
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.94	284.79	274.97	258.84	241.9	225.99	215.9	219.25	227.76	244.02	262.74	277.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

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North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	348.42	405.72	476.99	567.17	637.89	640.76	606.82	541.89	466.35	387.72	340.26	329.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.59	0.66	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.56	19.86	20.28	20.67	20.9	20.97	20.95	20.75	20.26	19.75	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.47	18.78	19.2	19.55	19.74	19.78	19.77	19.64	19.18	18.68	18.29	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.51	0.58	0.85	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.42	403.36	469.71	539.11	546.93	438.53	307.71	316.12	397.47	378.06	338.45	328.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1264.17	1223.61	1108.68	928.74	717.94	482.83	316.87	332.51	516.49	779.16	1040.27	1261.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	682.06	551.2	475.39	280.53	127.23	0	0	0	0	298.42	505.32	694.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3614.46 (98)

Space heating requirement in kWh/m²/year 58.28 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	801.91	631.29	647.43	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	661.54	561.75	549.54	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	824.92	783.75	709.04	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	117.63	165.17	118.67	0	0	0	0

Total = Sum(104)$_{6...8}$ = 401.47 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	29.41	41.29	29.67	0	0	0	0

Total = Sum(107)$_{6...8}$ = 100.37 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.62 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.9 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28

Average = Sum(39)$_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = $Sum(40)_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = $Sum(44)_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = $Sum(45)_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.96	284.81	274.99	258.85	241.91	225.99	215.91	219.26	227.77	244.03	262.76	277.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.56	396.29	461.22	543.08	606.94	608.33	576.26	516.67	447.72	376.5	334.23	325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.58	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.49	19.65	19.93	20.33	20.69	20.91	20.98	20.96	20.77	20.31	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.65	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.46	18.61	18.9	19.3	19.63	19.81	19.84	19.84	19.71	19.28	18.81	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.95	0.86	0.69	0.51	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.68	394.23	454.86	518.11	523.61	418.4	293	301.67	382.78	367.72	332.6	324.35	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1198.12	1159.14	1049.69	878.34	678.75	456.65	300.45	315.23	489.13	738.04	985.53	1195.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	636.45	514.02	442.55	259.36	115.43	0	0	0	0	275.52	470.11	647.85	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3361.29 (98)

Space heating requirement in kWh/m²/year 54.2 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	752.42	592.33	607.41	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	631.25	534.31	524.8	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	787.03	748.04	679.58	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	112.16	159.01	115.15	0	0	0	0	

Total = Sum(104)6...8 = 386.32 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104)6...8 = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	28.04	39.75	28.79	0	0	0	0	

Total = Sum(107)6...8 = 96.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.56 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 55.75 (109)

Target Fabric Energy Efficiency (TFEE) 64.12 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.58	13.15	14.52	14.02	14.45	13.95	14.4	14.43	13.99	14.5	14.07	14.57	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	

Output from water heater (annual)$_{1...12}$ 1470.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.45	42.47	44.07	38.76	37.44	32.68	30.65	34.65	34.91	40.23	43.48	47.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.67	35.24	28.66	21.7	16.22	13.69	14.79	19.23	25.81	32.77	38.25	40.78	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	265.69	268.45	261.5	246.71	228.04	210.49	198.77	196.01	202.96	217.75	236.42	253.97	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	65.12	63.21	59.23	53.83	50.32	45.39	41.19	46.57	48.48	54.07	60.38	63.22	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	463.51	459.92	442.42	415.26	387.61	362.6	347.78	354.84	370.28	397.62	428.08	450.99	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

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North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	525.99	580.85	644.43	723.6	783.6	777.37	738.71	677.47	608.87	541.32	505.61	502.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.82	0.65	0.49	0.55	0.8	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.8	20.08	20.46	20.77	20.94	20.99	20.98	20.85	20.45	19.98	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.9	0.76	0.55	0.36	0.42	0.71	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.23	18.63	19.17	19.57	19.75	19.78	19.78	19.67	19.17	18.5	17.96	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.75	18.94	19.29	19.75	20.11	20.28	20.32	20.32	20.2	19.74	19.17	18.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.6	18.79	19.14	19.6	19.96	20.13	20.17	20.17	20.05	19.59	19.02	18.56	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.9	0.77	0.58	0.41	0.46	0.73	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	518.43	567.65	615.87	648.36	603.84	449.51	300.89	314.27	447.04	500.73	493.43	496.63	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.27	1208.41	1097.6	921.31	709.98	472.08	304.67	320.83	509.1	773.21	1028.03	1242.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	541.52	430.59	358.41	196.52	78.97	0	0	0	0	202.73	384.91	555.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2748.69 (98)

Space heating requirement in kWh/m²/year 44.32 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	541.52	430.59	358.41	196.52	78.97	0	0	0	0	202.73	384.91	555.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	598.36	475.79	396.03	217.15	87.26	0	0	0	0	224.01	425.32	613.3	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3037.23 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	
Efficiency of water heater												87.3	(216)
(217)m=	89.79	89.73	89.6	89.26	88.57	87.3	87.3	87.3	87.3	89.25	89.65	89.82	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	166.32	146	151.95	134.49	131.19	116.55	109.68	123.47	124.23	139.59	149.75	161.52	

Total = Sum(219a)$_{1...12}$ = 1654.71 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3037.23

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Water heating fuel used			1654.71	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.27	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	105.7	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	57.58	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.97	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	330.14	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.3	(257)
SAP rating (Section 12)		81.93	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	656.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	357.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1013.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Total CO2, kg/year		sum of (265)…(271) =		1197.84	(272)
CO2 emissions per m²		(272) ÷ (4) =		19.31	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3705.42	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2018.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5724.16	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	860.42	(268)
'Total Primary Energy			sum of (265)…(271) =		6814.83	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		109.88	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - Baseline

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28	

Average = $Sum(39)_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.3	40.3	42.94	39.92	39.57	36.66	37.89	39.57	39.92	42.94	43.18	46.3	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8	

Output from water heater (annual)1…12 | 1795.21 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	56.38	49.26	51.17	45.23	43.72	38.36	36.52	40.93	41.39	47.34	50.75	54.97	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	75.78	73.31	68.78	62.83	58.76	53.27	49.09	55.02	57.49	63.63	70.49	73.88	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	326.26	323.85	312.03	293.38	274.62	256.36	244.76	250.62	260.38	279.22	300.78	316.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

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North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	383.85	435.33	498.26	577.62	639.64	638.69	605.11	548.03	480.32	411.69	372.25	364.6	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.72	0.56	0.63	0.87	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.7	19.98	20.38	20.72	20.92	20.98	20.97	20.8	20.36	19.89	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.42	0.49	0.8	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.13	18.54	19.11	19.57	19.8	19.84	19.84	19.68	19.09	18.41	17.88	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.65	18.84	19.19	19.68	20.09	20.3	20.35	20.35	20.19	19.66	19.08	18.62	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.65	18.84	19.19	19.68	20.09	20.3	20.35	20.35	20.19	19.66	19.08	18.62		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	0.99	0.98	0.94	0.84	0.66	0.49	0.56	0.83	0.97	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	382.18	431.81	488.61	544.25	538.9	423.63	294.29	304.29	397.56	398.01	369.28	363.34		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1175.58	1139.55	1035.57	871.38	676.93	456.61	300.52	315.38	488.71	731.26	969.81	1172.1		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	590.29	475.6	406.93	235.53	102.69	0	0	0	0	247.94	432.38	601.72		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3093.09	(98)
Space heating requirement in kWh/m²/year													49.87	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	590.29	475.6	406.93	235.53	102.69	0	0	0	0	247.94	432.38	601.72		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	632.01	509.21	435.69	252.18	109.95	0	0	0	0	265.46	462.93	644.24		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3311.66	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8		
Efficiency of water heater													80.3	(216)
(217)m=	87.81	87.65	87.24	86.25	84.26	80.3	80.3	80.3	80.3	86.26	87.39	87.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	206.2	180.44	188.62	169.22	167.7	154.99	148.49	165.53	167.36	177.4	186.93	201.17		
Total = Sum(219a)$_{1...12}$ =													2114.04	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3311.66

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Water heating fuel used			2114.04	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	715.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1171.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.66	(268)
Total CO2, kg/year		sum of (265)…(271) =		1356.54	(272)

TER =	21.87	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:34

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 62.02m²

Site Reference : Lawnwood House **Plot Reference:** Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.87 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.42 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.45 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.65m²	
Windows facing: North	8.79m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.58	13.15	14.52	14.02	14.45	13.95	14.4	14.43	13.99	14.5	14.07	14.57	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	

Output from water heater (annual)$_{1…12}$ 1470.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.45	42.47	44.07	38.76	37.44	32.68	30.65	34.65	34.91	40.23	43.48	47.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	65.12	63.21	59.23	53.83	50.32	45.39	41.19	46.57	48.48	54.07	60.38	63.22	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	315.58	313.73	302.47	284.37	266.17	248.46	236.86	242.16	251.36	269.64	290.66	306.26	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	378.05	434.66	504.48	592.71	662.16	663.23	627.78	564.79	489.95	413.34	368.18	357.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.73	0.57	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.44	19.6	19.9	20.31	20.69	20.91	20.98	20.96	20.77	20.29	19.79	19.41	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.43	0.5	0.81	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.7	17.94	18.37	18.97	19.47	19.72	19.77	19.77	19.59	18.95	18.23	17.66	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.48	18.68	19.06	19.58	20.02	20.26	20.31	20.3	20.12	19.55	18.93	18.45	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.33	18.53	18.91	19.43	19.87	20.11	20.16	20.15	19.97	19.4	18.78	18.3	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.54	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	376.36	430.97	494.09	556.41	553.37	433.63	297.33	307.66	403.35	399.19	365.17	356.69	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1223.5	1186.4	1077.83	906.39	702.04	469.68	304.09	319.78	502.28	756.78	1007.52	1220.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	630.27	507.65	434.31	251.99	110.61	0	0	0	0	266.05	462.49	642.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3305.94 (98)

Space heating requirement in kWh/m²/year 53.3 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	630.27	507.65	434.31	251.99	110.61	0	0	0	0	266.05	462.49	642.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	696.43	560.94	479.9	278.44	122.23	0	0	0	0	293.98	511.04	710.03		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3652.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07		
Efficiency of water heater													87.3	(216)
(217)m=	89.87	89.82	89.72	89.44	88.83	87.3	87.3	87.3	87.3	89.45	89.76	89.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	166.17	145.85	151.75	134.21	130.8	116.55	109.68	123.47	124.23	139.27	149.56	161.38		
Total = Sum(219a)$_{1...12}$ =													1652.92	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3652.98

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Water heating fuel used			1652.92	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.27	(232)
Electricity generated by PVs			-482.15	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	789.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	357.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1146.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Energy saving/generation technologies Item 1		0.519	=	-250.24	(269)
Total CO2, kg/year		sum of (265)…(271) =		1080.22	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.42	(273)
EI rating (section 14)				86	(274)

Predicted Energy Assessment

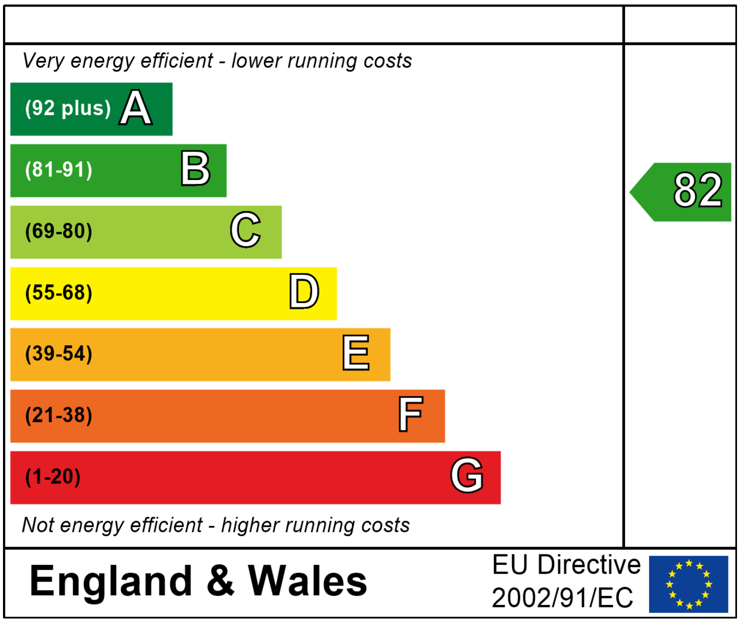
Flat 2
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type: Mid floor Flat
Date of assessment: 20 April 2020
Produced by: Benjamin Leech
Total floor area: 62.02 m²

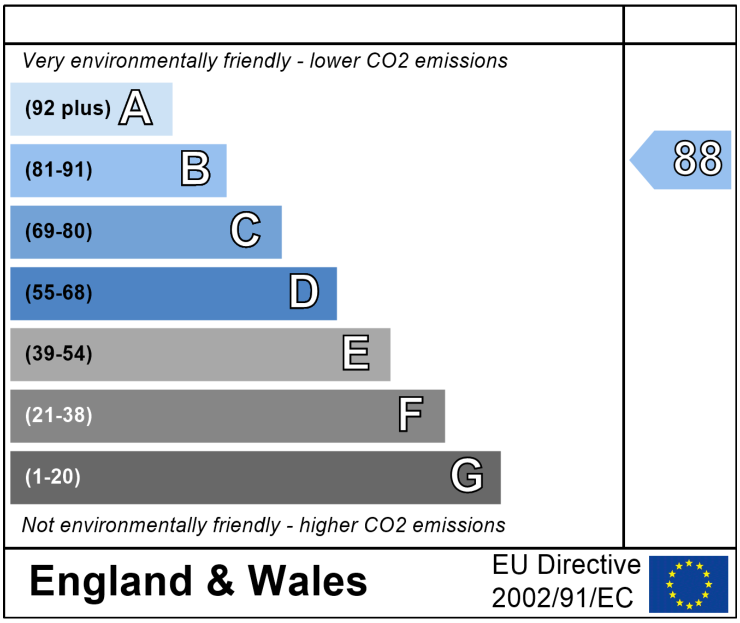
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55

Average = Sum(39)$_{1…12}$ /12= 86.11 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4	

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = Sum(44)$_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = Sum(45)$_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1…12}$ | 1104.75 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.87	14.1	11.46	8.68	6.49	5.48	5.92	7.69	10.32	13.11	15.3	16.31	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.94	284.79	274.97	258.84	241.9	225.99	215.9	219.25	227.76	244.02	262.74	277.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	348.42	405.72	476.99	567.17	637.89	640.76	606.82	541.89	466.35	387.72	340.26	329.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.59	0.66	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.56	19.86	20.28	20.67	20.9	20.97	20.95	20.75	20.26	19.75	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.47	18.78	19.2	19.55	19.74	19.78	19.77	19.64	19.18	18.68	18.29	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.8	18.96	19.26	19.69	20.05	20.26	20.31	20.3	20.14	19.66	19.16	18.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.51	0.58	0.85	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.42	403.36	469.71	539.11	546.93	438.53	307.71	316.12	397.47	378.06	338.45	328.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1264.17	1223.61	1108.68	928.74	717.94	482.83	316.87	332.51	516.49	779.16	1040.27	1261.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	682.06	551.2	475.39	280.53	127.23	0	0	0	0	298.42	505.32	694.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3614.46 (98)

Space heating requirement in kWh/m²/year 58.28 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	801.91	631.29	647.43	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	661.54	561.75	549.54	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	824.92	783.75	709.04	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	117.63	165.17	118.67	0	0	0	0	

Total = Sum(104)$_{6..8}$ = 401.47 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	29.41	41.29	29.67	0	0	0	0

Total = Sum(107)$_{6..8}$ = 100.37 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.62 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 59.9 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28

Average = Sum(39)$_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = $Sum(40)_{1…12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87

Total = $Sum(44)_{1…12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5

Total = $Sum(45)_{1…12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	114.54	100.18	103.37	90.12	86.48	74.62	69.15	79.35	80.3	93.58	102.15	110.93	

Output from water heater (annual)$_{1...12}$ 1104.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.63	25.04	25.84	22.53	21.62	18.66	17.29	19.84	20.07	23.39	25.54	27.73	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	38.49	37.27	34.74	31.29	29.06	25.91	23.24	26.66	27.88	31.44	35.47	37.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	285.96	284.81	274.99	258.85	241.91	225.99	215.91	219.26	227.77	244.03	262.76	277.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.56	396.29	461.22	543.08	606.94	608.33	576.26	516.67	447.72	376.5	334.23	325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.58	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.49	19.65	19.93	20.33	20.69	20.91	20.98	20.96	20.77	20.31	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.65	0.44	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.46	18.61	18.9	19.3	19.63	19.81	19.84	19.84	19.71	19.28	18.81	18.44	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.93	19.08	19.36	19.77	20.11	20.31	20.35	20.34	20.19	19.75	19.27	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.95	0.86	0.69	0.51	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.68	394.23	454.86	518.11	523.61	418.4	293	301.67	382.78	367.72	332.6	324.35	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1198.12	1159.14	1049.69	878.34	678.75	456.65	300.45	315.23	489.13	738.04	985.53	1195.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	636.45	514.02	442.55	259.36	115.43	0	0	0	0	275.52	470.11	647.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3361.29 (98)

Space heating requirement in kWh/m²/year 54.2 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	752.42	592.33	607.41	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	631.25	534.31	524.8	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	787.03	748.04	679.58	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	112.16	159.01	115.15	0	0	0	0	

Total = Sum(104)$_{6..8}$ = 386.32 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	28.04	39.75	28.79	0	0	0	0

Total = Sum(107)$_{6..8}$ = 96.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.56 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 55.75 (109)

Target Fabric Energy Efficiency (TFEE) 64.12 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.02	(1a) x	2.3	(2a) =	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			5.65	x1/[1/(1.4)+ 0.04]		=	7.49			(27)
Windows Type 2			8.79	x1/[1/(1.4)+ 0.04]		=	11.65			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	16.64	27.45	x	0.18	=	4.94			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5465.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.72 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.44 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	87.18	87.02	86.86	86.11	85.97	85.31	85.31	85.19	85.56	85.97	86.25	86.55	

Average = $Sum(39)_{1...12}$ /12= 86.11 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.41	1.4	1.4	1.39	1.39	1.38	1.38	1.37	1.38	1.39	1.39	1.4	

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	

Total = $\text{Sum}(44)_{1\ldots12}$ = 991.27 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	

Total = $\text{Sum}(45)_{1\ldots12}$ = 1299.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	14.58	13.15	14.52	14.02	14.45	13.95	14.4	14.43	13.99	14.5	14.07	14.57	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07	

Output from water heater (annual)$_{1...12}$ 1470.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.45	42.47	44.07	38.76	37.44	32.68	30.65	34.65	34.91	40.23	43.48	47.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	122.29	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.67	35.24	28.66	21.7	16.22	13.69	14.79	19.23	25.81	32.77	38.25	40.78	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	265.69	268.45	261.5	246.71	228.04	210.49	198.77	196.01	202.96	217.75	236.42	253.97	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	49.27	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)

Water heating gains (Table 5)

(72)m=	65.12	63.21	59.23	53.83	50.32	45.39	41.19	46.57	48.48	54.07	60.38	63.22	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	463.51	459.92	442.42	415.26	387.61	362.6	347.78	354.84	370.28	397.62	428.08	450.99	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.79	x	10.63	x	0.63	x	0.7	=	28.56	(74)
North	0.9x	0.77	x	8.79	x	20.32	x	0.63	x	0.7	=	54.59	(74)
North	0.9x	0.77	x	8.79	x	34.53	x	0.63	x	0.7	=	92.76	(74)
North	0.9x	0.77	x	8.79	x	55.46	x	0.63	x	0.7	=	149	(74)
North	0.9x	0.77	x	8.79	x	74.72	x	0.63	x	0.7	=	200.71	(74)

North	0.9x	0.77	x	8.79	x	79.99	x	0.63	x	0.7	=	214.87	(74)
North	0.9x	0.77	x	8.79	x	74.68	x	0.63	x	0.7	=	200.61	(74)
North	0.9x	0.77	x	8.79	x	59.25	x	0.63	x	0.7	=	159.16	(74)
North	0.9x	0.77	x	8.79	x	41.52	x	0.63	x	0.7	=	111.53	(74)
North	0.9x	0.77	x	8.79	x	24.19	x	0.63	x	0.7	=	64.98	(74)
North	0.9x	0.77	x	8.79	x	13.12	x	0.63	x	0.7	=	35.24	(74)
North	0.9x	0.77	x	8.79	x	8.86	x	0.63	x	0.7	=	23.81	(74)
West	0.9x	0.77	x	5.65	x	19.64	x	0.63	x	0.7	=	33.91	(80)
West	0.9x	0.77	x	5.65	x	38.42	x	0.63	x	0.7	=	66.34	(80)
West	0.9x	0.77	x	5.65	x	63.27	x	0.63	x	0.7	=	109.25	(80)
West	0.9x	0.77	x	5.65	x	92.28	x	0.63	x	0.7	=	159.34	(80)
West	0.9x	0.77	x	5.65	x	113.09	x	0.63	x	0.7	=	195.28	(80)
West	0.9x	0.77	x	5.65	x	115.77	x	0.63	x	0.7	=	199.9	(80)
West	0.9x	0.77	x	5.65	x	110.22	x	0.63	x	0.7	=	190.32	(80)
West	0.9x	0.77	x	5.65	x	94.68	x	0.63	x	0.7	=	163.48	(80)
West	0.9x	0.77	x	5.65	x	73.59	x	0.63	x	0.7	=	127.07	(80)
West	0.9x	0.77	x	5.65	x	45.59	x	0.63	x	0.7	=	78.72	(80)
West	0.9x	0.77	x	5.65	x	24.49	x	0.63	x	0.7	=	42.29	(80)
West	0.9x	0.77	x	5.65	x	16.15	x	0.63	x	0.7	=	27.89	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	62.48	120.93	202.01	308.34	395.99	414.77	390.92	322.63	238.6	143.7	77.52	51.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	525.99	580.85	644.43	723.6	783.6	777.37	738.71	677.47	608.87	541.32	505.61	502.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.82	0.65	0.49	0.55	0.8	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.8	20.08	20.46	20.77	20.94	20.99	20.98	20.85	20.45	19.98	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.9	0.76	0.55	0.36	0.42	0.71	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.23	18.63	19.17	19.57	19.75	19.78	19.78	19.67	19.17	18.5	17.96	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.75	18.94	19.29	19.75	20.11	20.28	20.32	20.32	20.2	19.74	19.17	18.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.6	18.79	19.14	19.6	19.96	20.13	20.17	20.17	20.05	19.59	19.02	18.56	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.9	0.77	0.58	0.41	0.46	0.73	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	518.43	567.65	615.87	648.36	603.84	449.51	300.89	314.27	447.04	500.73	493.43	496.63	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.27	1208.41	1097.6	921.31	709.98	472.08	304.67	320.83	509.1	773.21	1028.03	1242.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	541.52	430.59	358.41	196.52	78.97	0	0	0	0	202.73	384.91	555.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2748.69 (98)

Space heating requirement in kWh/m²/year 44.32 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	541.52	430.59	358.41	196.52	78.97	0	0	0	0	202.73	384.91	555.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	598.36	475.79	396.03	217.15	87.26	0	0	0	0	224.01	425.32	613.3	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3037.23 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	149.34	131.01	136.14	120.04	116.19	101.74	95.75	107.79	108.45	124.59	134.25	145.07

Efficiency of water heater 87.3 (216)

(217)m=	89.79	89.73	89.6	89.26	88.57	87.3	87.3	87.3	87.3	89.25	89.65	89.82	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	166.32	146	151.95	134.49	131.19	116.55	109.68	123.47	124.23	139.59	149.75	161.52

Total = Sum(219a)$_{1...12}$ = 1654.71 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3037.23

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Water heating fuel used			1654.71	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.27	(232)
Electricity generated by PVs			-482.15	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	105.7	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	57.58	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.97	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	330.14	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.3	(257)
SAP rating (Section 12)		81.93	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	656.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	357.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1013.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.46	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-250.24	(269)

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Total CO2, kg/year	sum of (265)…(271) =	947.6	(272)
CO2 emissions per m²	(272) ÷ (4) =	15.28	(273)
EI rating (section 14)		88	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3705.42	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2018.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5724.16	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	860.42	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1480.21	(269)
'Total Primary Energy		sum of (265)…(271) =			5334.62	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			86.01	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 2 - PV

Address : Flat 2, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	62.02	(1a)	x	2.3	(2a)	=	142.65	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.02	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			142.65	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.41	0.36	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			5.21	x1/[1/(1.4)+ 0.04]		=	6.91			(27)
Windows Type 2			8.1	x1/[1/(1.4)+ 0.04]		=	10.74			(27)
Floor			62.02	x	0.13	=	8.0626			(28)
Walls	44.09	15.51	28.58	x	0.18	=	5.14			(29)
Roof	4.71	0	4.71	x	0.13	=	0.61			(30)
Total area of elements, m²			110.82							(31)
Party wall			30.87	x	0	=	0			(32)
Party ceiling			57.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5532.94 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 20.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.17 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.75	27.58	27.42	26.67	26.53	25.87	25.87	25.75	26.13	26.53	26.81	27.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.92	81.75	81.59	80.84	80.7	80.04	80.04	79.92	80.3	80.7	80.98	81.28	

Average = Sum(39)$_{1…12}$ /12= 80.84 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.32	1.32	1.32	1.3	1.3	1.29	1.29	1.29	1.29	1.3	1.31	1.31

Average = Sum(40)$_{1...12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.87	87.56	84.26	80.95	77.65	74.35	74.35	77.65	80.95	84.26	87.56	90.87	
										Total = Sum(44)$_{1...12}$ =		991.27	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	134.75	117.85	121.62	106.03	101.74	87.79	81.35	93.35	94.47	110.09	120.17	130.5	
										Total = Sum(45)$_{1...12}$ =		1299.71	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.03	19.58	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.3	40.3	42.94	39.92	39.57	36.66	37.89	39.57	39.92	42.94	43.18	46.3	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8	

Output from water heater (annual)$_{1...12}$ 1795.21 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	56.38	49.26	51.17	45.23	43.72	38.36	36.52	40.93	41.39	47.34	50.75	54.97	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	101.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.89	14.12	11.48	8.69	6.5	5.48	5.93	7.7	10.34	13.13	15.32	16.33	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	178.01	179.86	175.2	165.29	152.78	141.03	133.17	131.33	135.98	145.89	158.4	170.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	33.19	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	-81.53	(71)
Water heating gains (Table 5)													
(72)m=	75.78	73.31	68.78	62.83	58.76	53.27	49.09	55.02	57.49	63.63	70.49	73.88	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	326.26	323.85	312.03	293.38	274.62	256.36	244.76	250.62	260.38	279.22	300.78	316.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	8.1	x	10.63	x	0.63	x	0.7	=	26.32	(74)
North	0.9x	0.77	x	8.1	x	20.32	x	0.63	x	0.7	=	50.3	(74)
North	0.9x	0.77	x	8.1	x	34.53	x	0.63	x	0.7	=	85.48	(74)
North	0.9x	0.77	x	8.1	x	55.46	x	0.63	x	0.7	=	137.3	(74)
North	0.9x	0.77	x	8.1	x	74.72	x	0.63	x	0.7	=	184.96	(74)

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North	0.9x	0.77	x	8.1	x	79.99	x	0.63	x	0.7	=	198	(74)
North	0.9x	0.77	x	8.1	x	74.68	x	0.63	x	0.7	=	184.86	(74)
North	0.9x	0.77	x	8.1	x	59.25	x	0.63	x	0.7	=	146.66	(74)
North	0.9x	0.77	x	8.1	x	41.52	x	0.63	x	0.7	=	102.77	(74)
North	0.9x	0.77	x	8.1	x	24.19	x	0.63	x	0.7	=	59.88	(74)
North	0.9x	0.77	x	8.1	x	13.12	x	0.63	x	0.7	=	32.47	(74)
North	0.9x	0.77	x	8.1	x	8.86	x	0.63	x	0.7	=	21.94	(74)
West	0.9x	0.77	x	5.21	x	19.64	x	0.63	x	0.7	=	31.27	(80)
West	0.9x	0.77	x	5.21	x	38.42	x	0.63	x	0.7	=	61.17	(80)
West	0.9x	0.77	x	5.21	x	63.27	x	0.63	x	0.7	=	100.75	(80)
West	0.9x	0.77	x	5.21	x	92.28	x	0.63	x	0.7	=	146.93	(80)
West	0.9x	0.77	x	5.21	x	113.09	x	0.63	x	0.7	=	180.07	(80)
West	0.9x	0.77	x	5.21	x	115.77	x	0.63	x	0.7	=	184.33	(80)
West	0.9x	0.77	x	5.21	x	110.22	x	0.63	x	0.7	=	175.49	(80)
West	0.9x	0.77	x	5.21	x	94.68	x	0.63	x	0.7	=	150.75	(80)
West	0.9x	0.77	x	5.21	x	73.59	x	0.63	x	0.7	=	117.17	(80)
West	0.9x	0.77	x	5.21	x	45.59	x	0.63	x	0.7	=	72.59	(80)
West	0.9x	0.77	x	5.21	x	24.49	x	0.63	x	0.7	=	38.99	(80)
West	0.9x	0.77	x	5.21	x	16.15	x	0.63	x	0.7	=	25.72	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	57.59	111.48	186.22	284.23	365.03	382.34	360.35	297.41	219.94	132.47	71.46	47.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	383.85	435.33	498.26	577.62	639.64	638.69	605.11	548.03	480.32	411.69	372.25	364.6	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.72	0.56	0.63	0.87	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.7	19.98	20.38	20.72	20.92	20.98	20.97	20.8	20.36	19.89	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.84	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.42	0.49	0.8	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.13	18.54	19.11	19.57	19.8	19.84	19.84	19.68	19.09	18.41	17.88	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.65	18.84	19.19	19.68	20.09	20.3	20.35	20.35	20.19	19.66	19.08	18.62	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.65	18.84	19.19	19.68	20.09	20.3	20.35	20.35	20.19	19.66	19.08	18.62	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.66	0.49	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	382.18	431.81	488.61	544.25	538.9	423.63	294.29	304.29	397.56	398.01	369.28	363.34	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1175.58	1139.55	1035.57	871.38	676.93	456.61	300.52	315.38	488.71	731.26	969.81	1172.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	590.29	475.6	406.93	235.53	102.69	0	0	0	0	247.94	432.38	601.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3093.09 (98)

Space heating requirement in kWh/m²/year 49.87 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	590.29	475.6	406.93	235.53	102.69	0	0	0	0	247.94	432.38	601.72		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	632.01	509.21	435.69	252.18	109.95	0	0	0	0	265.46	462.93	644.24		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3311.66	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	181.06	158.16	164.55	145.95	141.31	124.45	119.24	132.92	134.39	153.03	163.35	176.8		
Efficiency of water heater													80.3	(216)
(217)m=	87.81	87.65	87.24	86.25	84.26	80.3	80.3	80.3	80.3	86.26	87.39	87.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	206.2	180.44	188.62	169.22	167.7	154.99	148.49	165.53	167.36	177.4	186.93	201.17		
Total = Sum(219a)$_{1...12}$ =													2114.04	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3311.66

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Water heating fuel used			2114.04	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			280.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	715.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1171.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	145.66	(268)
Total CO2, kg/year		sum of (265)…(271) =		1356.54	(272)

TER = 21.87 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:14

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 60.4m²

Site Reference : Lawnwood House **Plot Reference:** Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity		
Fuel factor: 1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	32.29 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	27.95 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	**OK**
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.46 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	**OK**
Primary pipework insulated:	Yes	**OK**

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North	6.62m²
Windows facing: North East	4.2m²
Windows facing: East	2.24m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	

Output from water heater (annual)$_{1...12}$ | 2010.04 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.63	83.31	89.32	82.61	82.8	76.63	76.11	80.05	78.82	85.54	87.26	92.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	125.85	123.97	120.06	114.74	111.29	106.43	102.3	107.59	109.47	114.97	121.19	123.98	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	371.22	369.41	358.38	340.65	322.83	305.49	294.12	299.34	308.35	326.26	346.84	362.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.67	466.3	524.66	603.26	668.66	671.57	637.59	577.24	507.44	442.43	408.37	402.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.98	0.95	0.86	0.7	0.54	0.61	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.7	19.98	20.38	20.73	20.93	20.98	20.97	20.81	20.37	19.9	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.81	0.6	0.4	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.89	18.1	18.51	19.08	19.54	19.76	19.8	19.8	19.65	19.08	18.4	17.86	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.81	19.16	19.66	20.07	20.28	20.33	20.32	20.17	19.65	19.07	18.6	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.81	19.16	19.66	20.07	20.28	20.33	20.32	20.17	19.65	19.07	18.6	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.64	0.47	0.53	0.8	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	417.76	460.97	511.67	562.23	551.44	429.64	296.49	307.09	408.32	422.94	403.33	400.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1189.19	1152.15	1046.75	880.97	684.13	460.7	302.35	317.46	493.69	740.35	981.88	1186.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	573.95	464.47	398.1	229.49	98.72	0	0	0	0	236.15	416.56	584.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3001.8 (98)

Space heating requirement in kWh/m²/year 49.7 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	573.95	464.47	398.1	229.49	98.72	0	0	0	0	236.15	416.56	584.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	337.62	273.22	234.18	134.99	58.07	0	0	0	0	138.91	245.03	343.74	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1765.77 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57

Efficiency of water heater 170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	170	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	114.57	101.24	106.94	96.72	95.4	86.13	83.56	90.53	90.01	100.25	104.93	112.1

Total = Sum(219a)$_{1...12}$ = 1182.38 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1765.77	
Water heating fuel used			1182.38	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			274.16	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	916.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	613.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1530.09	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	142.29	(268)
Total CO2, kg/year		sum of (265)…(271) =		1687.95	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		27.95	(273)
EI rating (section 14)				79	(274)

Predicted Energy Assessment

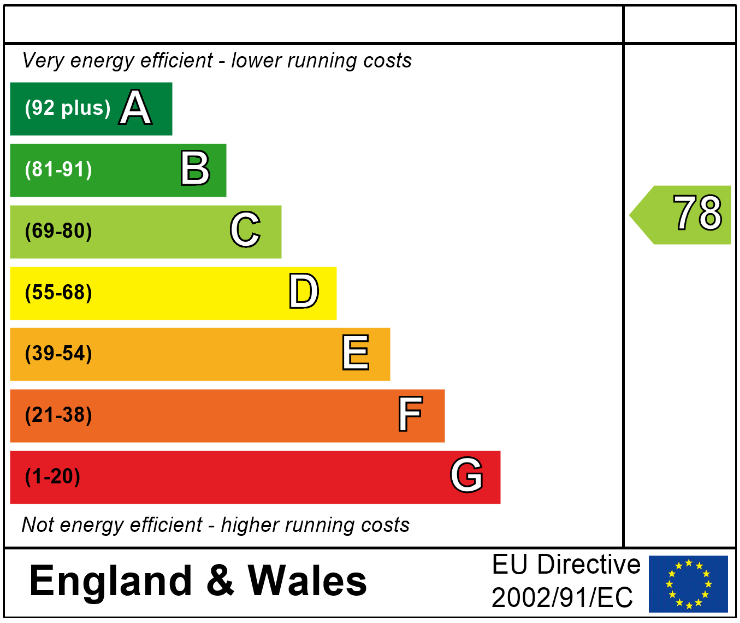
Flat 3
Lawnwood House, Lawnwood Road, Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Mid floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	60.4 m²

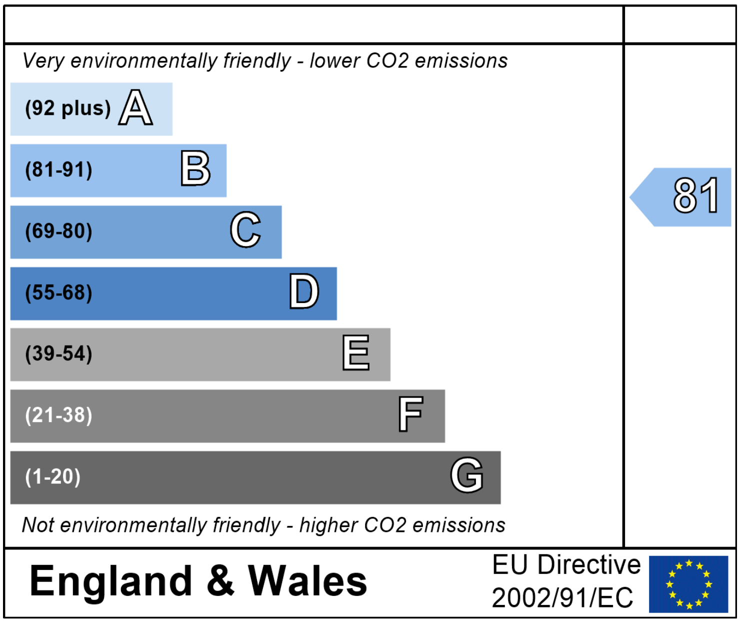
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.37	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5362.92	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DFEE WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

DFEE WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1...12}$ | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)
Water heating gains (Table 5)													
(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	280.36	279.23	269.6	253.8	237.22	221.64	211.75	215.07	223.39	239.32	257.66	271.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.8	376.12	435.89	516.41	583.05	587.72	555.22	492.97	422.48	355.49	319.18	312.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.91	0.76	0.61	0.69	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.42	19.57	19.85	20.27	20.65	20.89	20.97	20.95	20.73	20.25	19.77	19.4	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.54	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.5	18.79	19.2	19.56	19.76	19.8	19.79	19.65	19.19	18.71	18.34	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.53	0.61	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.97	374.31	430.53	495.14	509.28	414.04	292.4	299.33	368.23	348.17	317.72	312.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1205.74	1165.84	1055.08	882.75	682.53	459.47	301.91	316.66	490.86	741.26	991.39	1203.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	652.32	531.91	464.66	279.08	128.89	0	0	0	0	292.46	485.05	662.87	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3497.24 (98)

Space heating requirement in kWh/m²/year 57.9 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	762.51	600.27	615.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	622.05	530.05	516.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	761.35	721.91	650.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	100.29	142.74	99.9	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 342.94 (104)

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Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	25.07	35.69	24.98	0	0	0	0

Total = Sum(107) = 85.73 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.42 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.32 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = Sum(39)$_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3	

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = Sum(44)$_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = Sum(45)$_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1...12}$ | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)
Water heating gains (Table 5)													
(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	280.37	279.23	269.61	253.8	237.23	221.64	211.76	215.07	223.4	239.33	257.67	271.93	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

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North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.2	374.93	433.84	513.17	578.8	583.21	551	489.55	420.03	354.06	318.43	312.24	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.9	0.75	0.59	0.67	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.64	19.92	20.32	20.69	20.91	20.98	20.96	20.76	20.3	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.53	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.61	18.89	19.3	19.64	19.82	19.85	19.85	19.71	19.28	18.81	18.45	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.69	0.51	0.59	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.41	373.19	428.55	491.54	502.42	403.72	282.92	290.68	363.69	346.7	317.01	311.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1158.59	1120.17	1013.79	848	655.6	441.16	290.24	304.45	471.96	712.46	952.45	1155.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	617.65	501.97	435.41	256.65	113.97	0	0	0	0	272.13	457.51	627.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3283.19 (98)

Space heating requirement in kWh/m²/year 54.36 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	727	572.32	586.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.98	515.47	504.31	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	756.09	716.98	646.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	105.92	149.92	105.64	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 361.49 (104)

TFEE WorkSheet: New dwelling design stage

Cooled fraction	f C = cooled area ÷ (4) =	1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	26.48	37.48	26.41	0	0	0	0

Total = Sum(107) = 90.37 (107)

Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.5 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	55.85 (109)
Target Fabric Energy Efficiency (TFEE)		64.23 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

SAP WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = Sum(39)$_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = Sum(40)$_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = Sum(44)$_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = Sum(45)$_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57

Output from water heater (annual)$_{1...12}$ | 2010.04 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.63	83.31	89.32	82.61	82.8	76.63	76.11	80.05	78.82	85.54	87.26	92.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	38.81	34.47	28.03	21.22	15.86	13.39	14.47	18.81	25.25	32.06	37.42	39.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	259.63	262.33	255.54	241.09	222.84	205.69	194.24	191.54	198.33	212.79	231.03	248.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	125.85	123.97	120.06	114.74	111.29	106.43	102.3	107.59	109.47	114.97	121.19	123.98	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	516.11	512.58	495.44	468.86	441.8	417.32	402.81	409.75	424.86	451.63	481.45	503.85	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	565.55	609.47	661.73	731.47	787.63	783.4	746.28	687.65	623.95	567.8	542.97	544.67	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.97	0.92	0.8	0.62	0.47	0.53	0.77	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.9	20.16	20.52	20.81	20.95	20.99	20.98	20.88	20.52	20.09	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.95	0.89	0.74	0.52	0.35	0.4	0.68	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.39	18.76	19.26	19.62	19.78	19.8	19.8	19.72	19.28	18.67	18.15	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.89	19.06	19.39	19.82	20.15	20.3	20.33	20.33	20.23	19.83	19.3	18.86	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.89	19.06	19.39	19.82	20.15	20.3	20.33	20.33	20.23	19.83	19.3	18.86	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.76	0.57	0.4	0.45	0.72	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	554.54	592.28	628.03	648.82	597.4	443.27	299.48	312.6	446.38	517.02	525.59	535.51	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1210.82	1172.96	1065.27	894.55	690.94	462.56	302.76	318.22	499.16	755.12	1001.13	1207.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	488.27	390.22	325.31	176.93	69.59	0	0	0	0	177.15	342.39	499.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2469.6 (98)

Space heating requirement in kWh/m²/year 40.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	488.27	390.22	325.31	176.93	69.59	0	0	0	0	177.15	342.39	499.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	287.22	229.54	191.36	104.07	40.94	0	0	0	0	104.2	201.41	293.97	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1452.71 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57

Efficiency of water heater 170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	170	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	114.57	101.24	106.94	96.72	95.4	86.13	83.56	90.53	90.01	100.25	104.93	112.1

Total = Sum(219a)$_{1...12}$ = 1182.38 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1452.71	
Water heating fuel used		1182.38	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		30	(231)
Electricity for lighting		274.16	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	191.61	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	155.96	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.16	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 387.69 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.54	(257)
SAP rating (Section 12)		78.45	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.519	=	753.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	613.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1367.61	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	142.29	(268)
Total CO2, kg/year		sum of (265)…(271) =		1525.47	(272)
CO2 emissions per m²		(272) ÷ (4) =		25.26	(273)
EI rating (section 14)				81	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	4459.81	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3629.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8089.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	841.67	(268)
'Total Primary Energy		sum of (265)…(271) =		9023.48	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		149.4	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = $Sum(39)_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3

Average = $Sum(40)_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55	

Output from water heater (annual)$_{1...12}$ | 1892.09 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	85.62	76.07	81.31	74.86	74.78	68.87	68.09	72.03	71.06	77.53	79.5	84.22	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	115.08	113.2	109.29	103.97	100.52	95.66	91.53	96.82	98.7	104.2	110.42	113.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	360.46	358.65	347.61	329.88	312.06	294.73	283.35	288.58	297.58	315.49	336.08	351.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

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North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.29	454.34	511.84	589.26	653.64	656.3	622.59	563.05	494.21	430.23	396.84	391.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.99	0.95	0.86	0.69	0.53	0.6	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.76	20.03	20.42	20.75	20.94	20.99	20.97	20.83	20.41	19.95	19.59	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.81	0.59	0.4	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.22	18.62	19.17	19.61	19.82	19.85	19.85	19.71	19.16	18.5	17.98	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.73	18.91	19.25	19.73	20.12	20.32	20.36	20.35	20.21	19.72	19.15	18.7	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.73	18.91	19.25	19.73	20.12	20.32	20.36	20.35	20.21	19.72	19.15	18.7	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.46	0.53	0.8	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	406.78	449.6	499.89	549.88	537.87	415.92	285.88	296.52	397.4	412.17	392.42	389.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.69	1106.97	1005.61	845.96	656.72	442.04	290.54	305.02	474.13	711.06	943.06	1139.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	547.52	441.76	376.26	213.18	88.43	0	0	0	0	222.37	396.46	557.7	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2843.67 (98)

Space heating requirement in kWh/m²/year 47.08 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	547.52	441.76	376.26	213.18	88.43	0	0	0	0	222.37	396.46	557.7	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	585.59	472.47	402.41	228	94.57	0	0	0	0	237.83	424.02	596.47	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3041.35 (211)

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Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55

Efficiency of water heater 79.8 (216)

(217)m=	87.54	87.34	86.85	85.67	83.43	79.8	79.8	79.8	79.8	85.69	87.02	87.63	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	211.05	186.69	197.79	180.61	182.39	171.34	165.46	180.31	179.59	187.2	193.86	206.05

Total = Sum(219a)$_{1...12}$ = 2242.34 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3041.35	
Water heating fuel used		2242.34	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		274.34	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	656.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	484.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1141.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.38	(268)
Total CO2, kg/year		sum of (265)…(271) =		1322.58	(272)

TER = 32.29 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:04

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 60.4m²

Site Reference : Lawnwood House **Plot Reference:** Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	32.29 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	22.44 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North	6.62m²
Windows facing: North East	4.2m²
Windows facing: East	2.24m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = Sum(39)$_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = Sum(40)$_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = Sum(44)$_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = Sum(45)$_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	

Output from water heater (annual) $_{1...12}$ | 2010.04 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.63	83.31	89.32	82.61	82.8	76.63	76.11	80.05	78.82	85.54	87.26	92.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	125.85	123.97	120.06	114.74	111.29	106.43	102.3	107.59	109.47	114.97	121.19	123.98	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	371.22	369.41	358.38	340.65	322.83	305.49	294.12	299.34	308.35	326.26	346.84	362.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.67	466.3	524.66	603.26	668.66	671.57	637.59	577.24	507.44	442.43	408.37	402.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	0.99	0.98	0.95	0.86	0.7	0.54	0.61	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.7	19.98	20.38	20.73	20.93	20.98	20.97	20.81	20.37	19.9	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.93	0.81	0.6	0.4	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.89	18.1	18.51	19.08	19.54	19.76	19.8	19.8	19.65	19.08	18.4	17.86	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.81	19.16	19.66	20.07	20.28	20.33	20.32	20.17	19.65	19.07	18.6	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.81	19.16	19.66	20.07	20.28	20.33	20.32	20.17	19.65	19.07	18.6	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.64	0.47	0.53	0.8	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	417.76	460.97	511.67	562.23	551.44	429.64	296.49	307.09	408.32	422.94	403.33	400.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1189.19	1152.15	1046.75	880.97	684.13	460.7	302.35	317.46	493.69	740.35	981.88	1186.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	573.95	464.47	398.1	229.49	98.72	0	0	0	0	236.15	416.56	584.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3001.8 (98)

Space heating requirement in kWh/m²/year 49.7 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	573.95	464.47	398.1	229.49	98.72	0	0	0	0	236.15	416.56	584.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	337.62	273.22	234.18	134.99	58.07	0	0	0	0	138.91	245.03	343.74	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1765.77 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57

Efficiency of water heater 170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	170	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	114.57	101.24	106.94	96.72	95.4	86.13	83.56	90.53	90.01	100.25	104.93	112.1

Total = Sum(219a)$_{1...12}$ = 1182.38 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1765.77	
Water heating fuel used			1182.38	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			274.16	(232)
Electricity generated by PVs			-640.33	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	916.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	613.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1530.09	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	142.29	(268)
Energy saving/generation technologies Item 1		0.519	=	-332.33	(269)
Total CO2, kg/year		sum of (265)…(271) =		1355.61	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.44	(273)
EI rating (section 14)				83	(274)

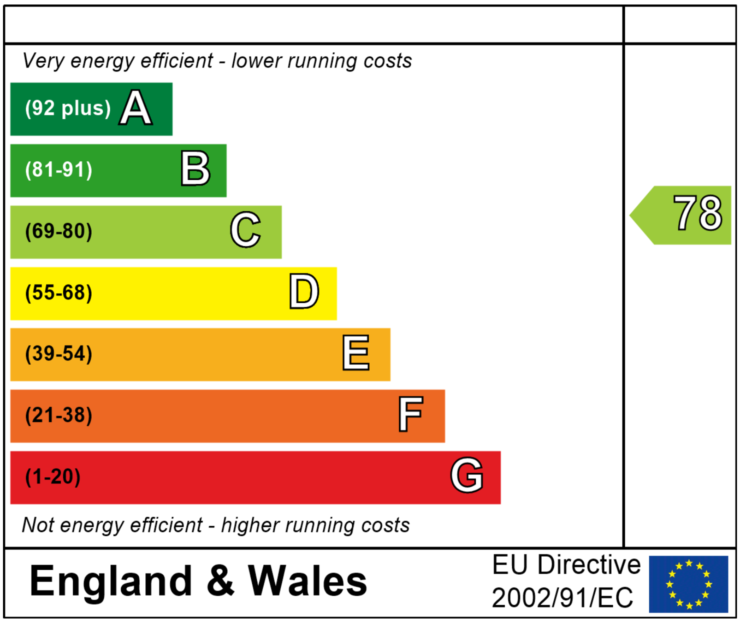
Predicted Energy Assessment

Flat 3	Dwelling type:	Mid floor Flat
Lawnwood House, Lawnwood Road, Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	60.4 m²
BS5 0EF		

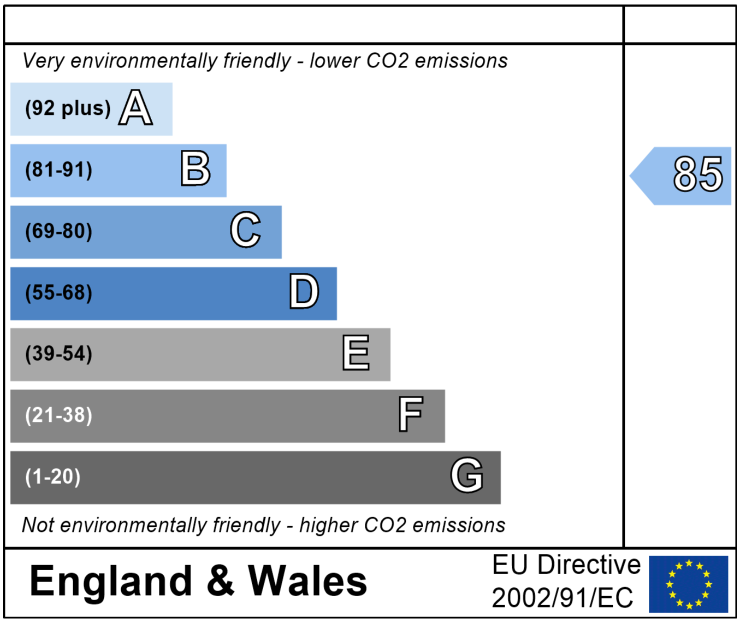
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3												0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	

Output from water heater (annual)$_{1\ldots12}$	1090.39	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)
Water heating gains (Table 5)													
(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	280.36	279.23	269.6	253.8	237.22	221.64	211.75	215.07	223.39	239.32	257.66	271.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

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North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.8	376.12	435.89	516.41	583.05	587.72	555.22	492.97	422.48	355.49	319.18	312.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.97	0.91	0.76	0.61	0.69	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.42	19.57	19.85	20.27	20.65	20.89	20.97	20.95	20.73	20.25	19.77	19.4	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.54	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.5	18.79	19.2	19.56	19.76	19.8	19.79	19.65	19.19	18.71	18.34	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.53	0.61	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.97	374.31	430.53	495.14	509.28	414.04	292.4	299.33	368.23	348.17	317.72	312.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1205.74	1165.84	1055.08	882.75	682.53	459.47	301.91	316.66	490.86	741.26	991.39	1203.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	652.32	531.91	464.66	279.08	128.89	0	0	0	0	292.46	485.05	662.87	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 3497.24 (98)

Space heating requirement in kWh/m²/year 57.9 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	762.51	600.27	615.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	622.05	530.05	516.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	761.35	721.91	650.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	100.29	142.74	99.9	0	0	0	0	

Total = $\text{Sum}(104)_{6...8}$ = 342.94 (104)

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Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	25.07	35.69	24.98	0	0	0	0

Total = Sum(107) = 85.73 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.42 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.32 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = $Sum(39)_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3

Average = $Sum(40)_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)1…12 | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.37	279.23	269.61	253.8	237.23	221.64	211.76	215.07	223.4	239.33	257.67	271.93	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

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North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.2	374.93	433.84	513.17	578.8	583.21	551	489.55	420.03	354.06	318.43	312.24	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.9	0.75	0.59	0.67	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.64	19.92	20.32	20.69	20.91	20.98	20.96	20.76	20.3	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.53	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.61	18.89	19.3	19.64	19.82	19.85	19.85	19.71	19.28	18.81	18.45	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.69	0.51	0.59	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.41	373.19	428.55	491.54	502.42	403.72	282.92	290.68	363.69	346.7	317.01	311.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1158.59	1120.17	1013.79	848	655.6	441.16	290.24	304.45	471.96	712.46	952.45	1155.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	617.65	501.97	435.41	256.65	113.97	0	0	0	0	272.13	457.51	627.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3283.19 (98)

Space heating requirement in kWh/m²/year 54.36 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	727	572.32	586.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.98	515.47	504.31	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	756.09	716.98	646.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	105.92	149.92	105.64	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 361.49 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	26.48	37.48	26.41	0	0	0	0

	Total = Sum(107) =	90.37	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.5	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	55.85	(109)
Target Fabric Energy Efficiency (TFEE)		64.23	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57

Output from water heater (annual)$_{1...12}$ | 2010.04 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.63	83.31	89.32	82.61	82.8	76.63	76.11	80.05	78.82	85.54	87.26	92.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	38.81	34.47	28.03	21.22	15.86	13.39	14.47	18.81	25.25	32.06	37.42	39.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	259.63	262.33	255.54	241.09	222.84	205.69	194.24	191.54	198.33	212.79	231.03	248.18	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)
Water heating gains (Table 5)													
(72)m=	125.85	123.97	120.06	114.74	111.29	106.43	102.3	107.59	109.47	114.97	121.19	123.98	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	516.11	512.58	495.44	468.86	441.8	417.32	402.81	409.75	424.86	451.63	481.45	503.85	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	565.55	609.47	661.73	731.47	787.63	783.4	746.28	687.65	623.95	567.8	542.97	544.67	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.98	0.97	0.92	0.8	0.62	0.47	0.53	0.77	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.9	20.16	20.52	20.81	20.95	20.99	20.98	20.88	20.52	20.09	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.95	0.89	0.74	0.52	0.35	0.4	0.68	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.39	18.76	19.26	19.62	19.78	19.8	19.8	19.72	19.28	18.67	18.15	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.89	19.06	19.39	19.82	20.15	20.3	20.33	20.33	20.23	19.83	19.3	18.86	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.89	19.06	19.39	19.82	20.15	20.3	20.33	20.33	20.23	19.83	19.3	18.86	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.76	0.57	0.4	0.45	0.72	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	554.54	592.28	628.03	648.82	597.4	443.27	299.48	312.6	446.38	517.02	525.59	535.51	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1210.82	1172.96	1065.27	894.55	690.94	462.56	302.76	318.22	499.16	755.12	1001.13	1207.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	488.27	390.22	325.31	176.93	69.59	0	0	0	0	177.15	342.39	499.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2469.6 (98)

Space heating requirement in kWh/m²/year 40.89 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	488.27	390.22	325.31	176.93	69.59	0	0	0	0	177.15	342.39	499.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	287.22	229.54	191.36	104.07	40.94	0	0	0	0	104.2	201.41	293.97	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1452.71 (211)

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Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	194.76	172.11	181.8	164.42	162.18	146.42	142.06	153.9	153.01	170.42	178.38	190.57		
Efficiency of water heater													170	(216)
(217)m=	170	170	170	170	170	170	170	170	170	170	170	170		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	114.57	101.24	106.94	96.72	95.4	86.13	83.56	90.53	90.01	100.25	104.93	112.1		
								Total = Sum(219a)$_{1...12}$ =					1182.38	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1452.71	
Water heating fuel used			1182.38	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			274.16	(232)
Electricity generated by PVs			-640.33	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	191.61	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	155.96	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.16	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	387.69	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.54	(257)
SAP rating (Section 12)		78.45	(258)

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12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	753.96	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	613.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1367.61	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	142.29	(268)
Energy saving/generation technologies Item 1			0.519	=	-332.33	(269)
Total CO2, kg/year			sum of (265)…(271) =		1193.13	(272)
CO2 emissions per m²			(272) ÷ (4) =		19.75	(273)
EI rating (section 14)					85	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	4459.81	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	3.07	=	3629.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =				8089.71	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	92.1	(267)
Electricity for lighting	(232)	x	0	=	841.67	(268)
Energy saving/generation technologies Item 1			3.07	=	-1965.83	(269)
'Total Primary Energy			sum of (265)…(271) =		7057.65	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		116.85	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - ASHP + PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = $Sum(39)_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3	

Average = $Sum(40)_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55

Output from water heater (annual)$_{1...12}$ | 1892.09 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	85.62	76.07	81.31	74.86	74.78	68.87	68.09	72.03	71.06	77.53	79.5	84.22	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	115.08	113.2	109.29	103.97	100.52	95.66	91.53	96.82	98.7	104.2	110.42	113.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	360.46	358.65	347.61	329.88	312.06	294.73	283.35	288.58	297.58	315.49	336.08	351.34	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

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North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	409.29	454.34	511.84	589.26	653.64	656.3	622.59	563.05	494.21	430.23	396.84	391.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	0.99	0.99	0.95	0.86	0.69	0.53	0.6	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.76	20.03	20.42	20.75	20.94	20.99	20.97	20.83	20.41	19.95	19.59	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.81	0.59	0.4	0.47	0.78	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.22	18.62	19.17	19.61	19.82	19.85	19.85	19.71	19.16	18.5	17.98	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.73	18.91	19.25	19.73	20.12	20.32	20.36	20.35	20.21	19.72	19.15	18.7	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.73	18.91	19.25	19.73	20.12	20.32	20.36	20.35	20.21	19.72	19.15	18.7	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.46	0.53	0.8	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	406.78	449.6	499.89	549.88	537.87	415.92	285.88	296.52	397.4	412.17	392.42	389.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.69	1106.97	1005.61	845.96	656.72	442.04	290.54	305.02	474.13	711.06	943.06	1139.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	547.52	441.76	376.26	213.18	88.43	0	0	0	0	222.37	396.46	557.7	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2843.67 (98)

Space heating requirement in kWh/m²/year 47.08 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	547.52	441.76	376.26	213.18	88.43	0	0	0	0	222.37	396.46	557.7	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	585.59	472.47	402.41	228	94.57	0	0	0	0	237.83	424.02	596.47	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3041.35 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

184.75	163.06	171.78	154.73	152.16	136.73	132.04	143.88	143.32	160.41	168.69	180.55

Efficiency of water heater 79.8 (216)

(217)m=	87.54	87.34	86.85	85.67	83.43	79.8	79.8	79.8	79.8	85.69	87.02	87.63	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	211.05	186.69	197.79	180.61	182.39	171.34	165.46	180.31	179.59	187.2	193.86	206.05

Total = Sum(219a)$_{1...12}$ = 2242.34 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3041.35	
Water heating fuel used			2242.34	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.34	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	656.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	484.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1141.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.38	(268)
Total CO2, kg/year		sum of (265)…(271) =		1322.58	(272)

TER = 32.29 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:35:24

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 60.4m²

Site Reference : Lawnwood House **Plot Reference:** Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	22.02 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.47 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: North	6.62m²
Windows facing: North East	4.2m²
Windows facing: East	2.24m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.52	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.07	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37

Output from water heater (annual)$_{1...12}$ | 1453.38 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.87	41.96	43.54	38.3	37	32.3	30.3	34.24	34.5	39.75	42.95	46.47	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	64.34	62.45	58.52	53.19	49.73	44.86	40.72	46.03	47.91	53.43	59.66	62.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	309.71	307.89	296.84	279.1	261.27	243.92	232.54	237.78	246.79	264.71	285.31	300.59	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

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North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	359.15	404.78	463.13	541.71	607.1	610	576.01	515.68	445.88	380.89	346.84	341.4	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.75	0.59	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.47	19.61	19.89	20.3	20.67	20.9	20.97	20.96	20.76	20.29	19.81	19.44	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.76	17.97	18.38	18.97	19.48	19.74	19.8	19.79	19.6	18.96	18.27	17.72	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.52	18.7	19.06	19.56	20.01	20.26	20.32	20.31	20.12	19.55	18.95	18.49	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.37	18.55	18.91	19.41	19.86	20.11	20.17	20.16	19.97	19.4	18.8	18.34	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	357.71	401.87	455.23	513.45	517.15	410.26	282.83	291.9	375.74	369.77	344.34	340.3	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1167.32	1130.44	1025.47	861.18	667.27	446.97	289.77	304.57	477.27	719.82	960.37	1164.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	602.35	489.6	424.26	250.37	111.69	0	0	0	0	260.44	443.54	613.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3195.29 (98)

Space heating requirement in kWh/m²/year 52.9 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	602.35	489.6	424.26	250.37	111.69	0	0	0	0	260.44	443.54	613.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	665.58	541	468.8	276.65	123.41	0	0	0	0	287.77	490.1	677.39	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 3530.71 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37		
Efficiency of water heater													87.3	(216)
(217)m=	89.85	89.81	89.71	89.45	88.85	87.3	87.3	87.3	87.3	89.45	89.74	89.88		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.24	144.15	149.99	132.66	129.28	115.23	108.46	122.07	122.82	137.68	147.84	159.52		
								Total = Sum(219a)$_{1...12}$ =					1633.94	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3530.71	
Water heating fuel used			1633.94	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.16	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	762.63	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	352.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1115.56	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.29	(268)
Total CO2, kg/year		sum of (265)…(271) =		1296.78	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.47	(273)
EI rating (section 14)				84	(274)

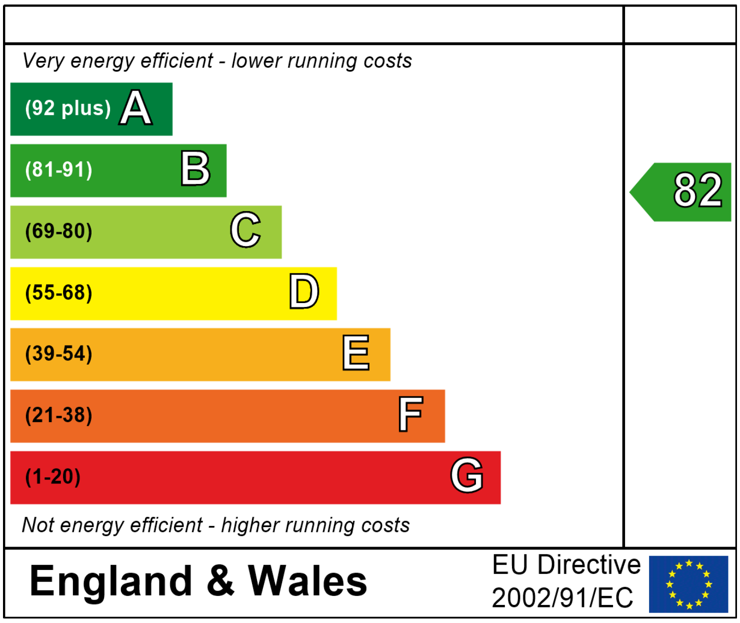
Predicted Energy Assessment

Flat 3 Lawnwood House, Lawnwood Road, Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Date of assessment: Produced by: Total floor area:	Mid floor Flat 20 April 2020 Benjamin Leech 60.4 m²

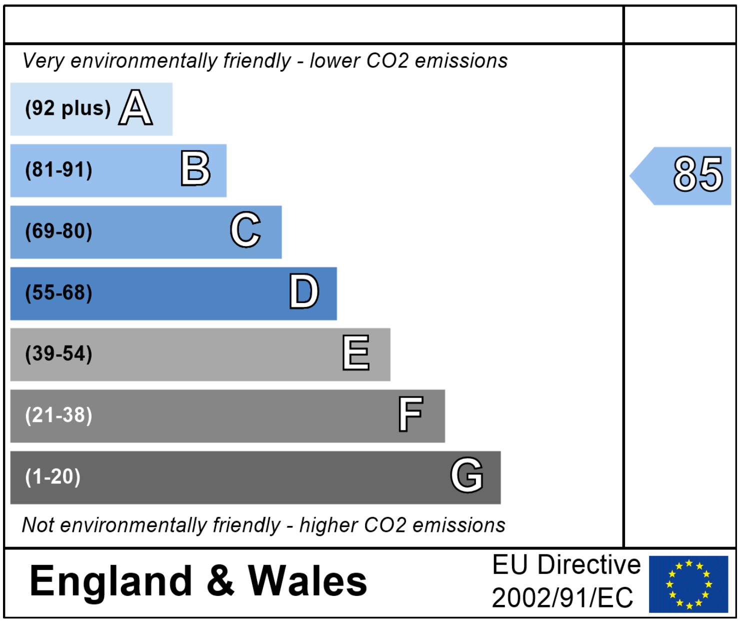
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $\text{Sum}(44)_{1\ldots12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $\text{Sum}(45)_{1\ldots12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1...12}$ | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.36	279.23	269.6	253.8	237.22	221.64	211.75	215.07	223.39	239.32	257.66	271.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.8	376.12	435.89	516.41	583.05	587.72	555.22	492.97	422.48	355.49	319.18	312.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.61	0.69	0.91	0.99	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	19.42	19.57	19.85	20.27	20.65	20.89	20.97	20.95	20.73	20.25	19.77	19.4	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.54	0.85	0.98	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	18.36	18.5	18.79	19.2	19.56	19.76	19.8	19.79	19.65	19.19	18.71	18.34	(90)

fLA = Living area ÷ (4) = 0.45 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2													
(92)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.53	0.61	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.97	374.31	430.53	495.14	509.28	414.04	292.4	299.33	368.23	348.17	317.72	312.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1205.74	1165.84	1055.08	882.75	682.53	459.47	301.91	316.66	490.86	741.26	991.39	1203.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	652.32	531.91	464.66	279.08	128.89	0	0	0	0	292.46	485.05	662.87	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3497.24 (98)

Space heating requirement in kWh/m²/year 57.9 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	762.51	600.27	615.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	622.05	530.05	516.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	761.35	721.91	650.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	100.29	142.74	99.9	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 342.94 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	25.07	35.69	24.98	0	0	0	0

	Total = Sum(107) =	85.73	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.42	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	59.32	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = $Sum(39)_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3	

Average = $Sum(40)_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1...12}$ | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.37	279.23	269.61	253.8	237.23	221.64	211.76	215.07	223.4	239.33	257.67	271.93	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.2	374.93	433.84	513.17	578.8	583.21	551	489.55	420.03	354.06	318.43	312.24	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.9	0.75	0.59	0.67	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.64	19.92	20.32	20.69	20.91	20.98	20.96	20.76	20.3	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.53	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.61	18.89	19.3	19.64	19.82	19.85	19.85	19.71	19.28	18.81	18.45	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.69	0.51	0.59	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.41	373.19	428.55	491.54	502.42	403.72	282.92	290.68	363.69	346.7	317.01	311.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1158.59	1120.17	1013.79	848	655.6	441.16	290.24	304.45	471.96	712.46	952.45	1155.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	617.65	501.97	435.41	256.65	113.97	0	0	0	0	272.13	457.51	627.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3283.19 (98)

Space heating requirement in kWh/m²/year 54.36 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	727	572.32	586.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.98	515.47	504.31	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	756.09	716.98	646.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	105.92	149.92	105.64	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 361.49 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	26.48	37.48	26.41	0	0	0	0

	Total = Sum(107) =	90.37	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.5	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	55.85	(109)
Target Fabric Energy Efficiency (TFEE)		64.23	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.52	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.07	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37

Output from water heater (annual)$_{1...12}$ | 1453.38 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.87	41.96	43.54	38.3	37	32.3	30.3	34.24	34.5	39.75	42.95	46.47	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	38.81	34.47	28.03	21.22	15.86	13.39	14.47	18.81	25.25	32.06	37.42	39.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	259.63	262.33	255.54	241.09	222.84	205.69	194.24	191.54	198.33	212.79	231.03	248.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	64.34	62.45	58.52	53.19	49.73	44.86	40.72	46.03	47.91	53.43	59.66	62.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.59	451.05	433.9	407.31	380.24	355.75	341.24	348.19	363.3	390.08	419.92	442.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	504.03	547.95	600.19	669.92	726.08	721.83	684.71	626.09	562.39	506.26	481.44	483.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.99	0.99	0.98	0.93	0.83	0.66	0.51	0.57	0.82	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.82	20.08	20.45	20.77	20.94	20.99	20.98	20.85	20.45	20	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.91	0.78	0.56	0.38	0.43	0.73	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.06	18.27	18.65	19.18	19.58	19.77	19.8	19.8	19.69	19.19	18.55	18.03	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.78	18.96	19.29	19.75	20.11	20.29	20.33	20.32	20.2	19.75	19.2	18.75	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.81	19.14	19.6	19.96	20.14	20.18	20.17	20.05	19.6	19.05	18.6	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.78	0.59	0.42	0.48	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	497.14	536.61	576.5	606.96	569.88	427.17	286.67	299.15	422.09	471.44	470.54	477.58	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1189.31	1151.76	1044.81	876.1	675.47	449.49	290.39	305.71	484.42	735.98	980.21	1185.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	514.97	413.38	348.42	193.79	78.56	0	0	0	0	196.82	366.96	526.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2639.8 (98)

Space heating requirement in kWh/m²/year 43.71 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	514.97	413.38	348.42	193.79	78.56	0	0	0	0	196.82	366.96	526.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	569.03	456.77	384.99	214.13	86.8	0	0	0	0	217.48	405.48	582.21	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2916.9 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37		
Efficiency of water heater													87.3	(216)
(217)m=	89.77	89.72	89.59	89.26	88.57	87.3	87.3	87.3	87.3	89.24	89.63	89.8		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.4	144.31	150.19	132.94	129.68	115.23	108.46	122.07	122.82	137.99	148.03	159.66		
								Total = Sum(219a)$_{1...12}$ =					1635.79	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2916.9	
Water heating fuel used			1635.79	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.16	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	101.51	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	56.93	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.16	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	324.49	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		81.96	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	630.05	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	353.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =				983.38	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	142.29	(268)
Total CO2, kg/year			sum of (265)…(271) =		1164.59	(272)
CO2 emissions per m²			(272) ÷ (4) =		19.28	(273)
EI rating (section 14)					85	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3558.62	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1995.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5554.28	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	841.67	(268)
'Total Primary Energy			sum of (265)…(271) =		6626.2	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		109.71	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - Baseline

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = Sum(39)$_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = Sum(44)$_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = Sum(45)$_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3												0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	45.7	39.78	42.38	39.4	39.05	36.19	37.39	39.05	39.4	42.38	42.62	45.7	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51	
									Output from water heater (annual)$_{1...12}$			1771.87	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	55.65	48.62	50.51	44.65	43.15	37.86	36.05	40.4	40.85	46.72	50.09	54.25	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)
Water heating gains (Table 5)													
(72)m=	74.8	72.35	67.88	62.01	58	52.58	48.45	54.3	56.74	62.8	69.57	72.92	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	320.18	317.8	306.21	287.92	269.55	251.65	240.27	246.06	255.62	274.09	295.23	311.06	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	369.01	413.5	470.44	547.3	611.12	613.22	579.52	520.53	452.25	388.83	356	351.37	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.88	0.72	0.57	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.7	19.97	20.37	20.72	20.92	20.98	20.97	20.79	20.35	19.89	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.63	0.43	0.5	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.13	18.53	19.1	19.57	19.81	19.85	19.84	19.68	19.09	18.42	17.89	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.65	18.83	19.18	19.67	20.08	20.3	20.35	20.34	20.18	19.65	19.07	18.62	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.65	18.83	19.18	19.67	20.08	20.3	20.35	20.34	20.18	19.65	19.07	18.62	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.56	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	367.48	410.45	462.22	517.9	517.94	409.01	284.23	293.44	379.11	377.06	353.35	350.21	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1136.74	1101.03	999.85	841.09	653.83	441.12	290.32	304.61	471.53	705.73	937.17	1133.33	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.33	464.07	400	232.7	101.1	0	0	0	0	244.53	420.35	582.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3017.72 (98)

Space heating requirement in kWh/m²/year 49.96 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	572.33	464.07	400	232.7	101.1	0	0	0	0	244.53	420.35	582.64	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	612.77	496.86	428.26	249.14	108.24	0	0	0	0	261.81	450.05	623.81	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3230.97 (211)

TER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51

Efficiency of water heater 80.3 (216)

(217)m=	87.77	87.63	87.23	86.25	84.26	80.3	80.3	80.3	80.3	86.26	87.35	87.85	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	203.6	178.15	186.19	167.01	165.53	152.97	146.56	163.38	165.18	175.1	184.57	198.63

Total = Sum(219a)$_{1...12}$ = 2086.87 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3230.97	
Water heating fuel used		2086.87	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		274.34	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	697.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	450.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1148.65	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.38	(268)
Total CO2, kg/year		sum of (265)…(271) =		1329.96	(272)

TER = 22.02 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:54

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 60.4m²

Site Reference : Lawnwood House **Plot Reference:** Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	22.02 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.44 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	59.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.46 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: North	6.62m²
Windows facing: North East	4.2m²
Windows facing: East	2.24m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = Sum(39)$_{1…12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = Sum(40)$_{1…12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = Sum(44)$_{1…12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = Sum(45)$_{1…12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.52	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.07	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37	

Output from water heater (annual)$_{1...12}$	1453.38	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.87	41.96	43.54	38.3	37	32.3	30.3	34.24	34.5	39.75	42.95	46.47	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	64.34	62.45	58.52	53.19	49.73	44.86	40.72	46.03	47.91	53.43	59.66	62.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	309.71	307.89	296.84	279.1	261.27	243.92	232.54	237.78	246.79	264.71	285.31	300.59	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	359.15	404.78	463.13	541.71	607.1	610	576.01	515.68	445.88	380.89	346.84	341.4	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.89	0.75	0.59	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.47	19.61	19.89	20.3	20.67	20.9	20.97	20.96	20.76	20.29	19.81	19.44	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.85	0.64	0.44	0.52	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.76	17.97	18.38	18.97	19.48	19.74	19.8	19.79	19.6	18.96	18.27	17.72	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.52	18.7	19.06	19.56	20.01	20.26	20.32	20.31	20.12	19.55	18.95	18.49	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.37	18.55	18.91	19.41	19.86	20.11	20.17	20.16	19.97	19.4	18.8	18.34	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	357.71	401.87	455.23	513.45	517.15	410.26	282.83	291.9	375.74	369.77	344.34	340.3	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1167.32	1130.44	1025.47	861.18	667.27	446.97	289.77	304.57	477.27	719.82	960.37	1164.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	602.35	489.6	424.26	250.37	111.69	0	0	0	0	260.44	443.54	613.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3195.29 (98)

Space heating requirement in kWh/m²/year 52.9 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	602.35	489.6	424.26	250.37	111.69	0	0	0	0	260.44	443.54	613.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	665.58	541	468.8	276.65	123.41	0	0	0	0	287.77	490.1	677.39	

Total (kWh/year) = $Sum(211)_{1...5,10...12}$ = 3530.71 (211)

DER WorkSheet: New dwelling design stage

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37		
Efficiency of water heater													87.3	(216)
(217)m=	89.85	89.81	89.71	89.45	88.85	87.3	87.3	87.3	87.3	89.45	89.74	89.88		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.24	144.15	149.99	132.66	129.28	115.23	108.46	122.07	122.82	137.68	147.84	159.52		
								Total = Sum(219a)$_{1...12}$ =					1633.94	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3530.71	
Water heating fuel used			1633.94	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.16	(232)
Electricity generated by PVs			-469.22	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	762.63	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	352.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1115.56	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.29	(268)
Energy saving/generation technologies Item 1		0.519	=	-243.53	(269)
Total CO2, kg/year		sum of (265)…(271) =		1053.25	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.44	(273)
EI rating (section 14)				87	(274)

Predicted Energy Assessment

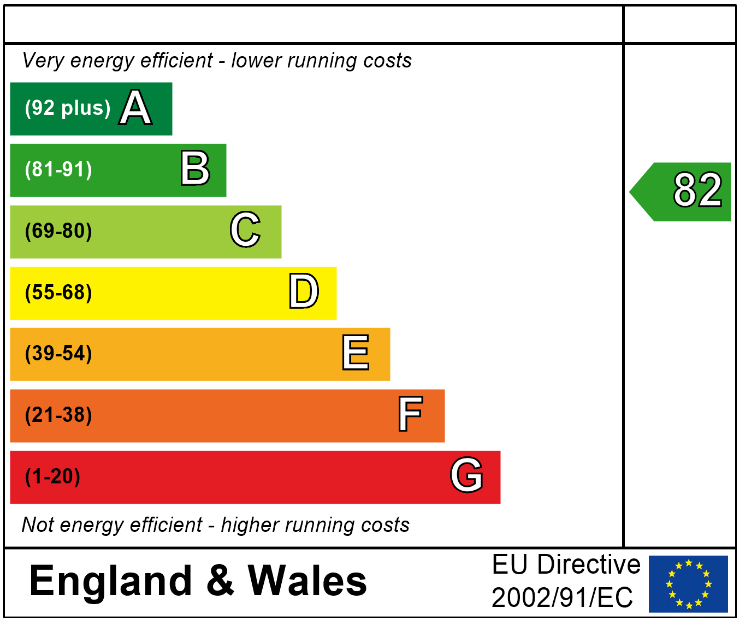
Flat 3
Lawnwood House, Lawnwood Road, Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type: Mid floor Flat
Date of assessment: 20 April 2020
Produced by: Benjamin Leech
Total floor area: 60.4 m²

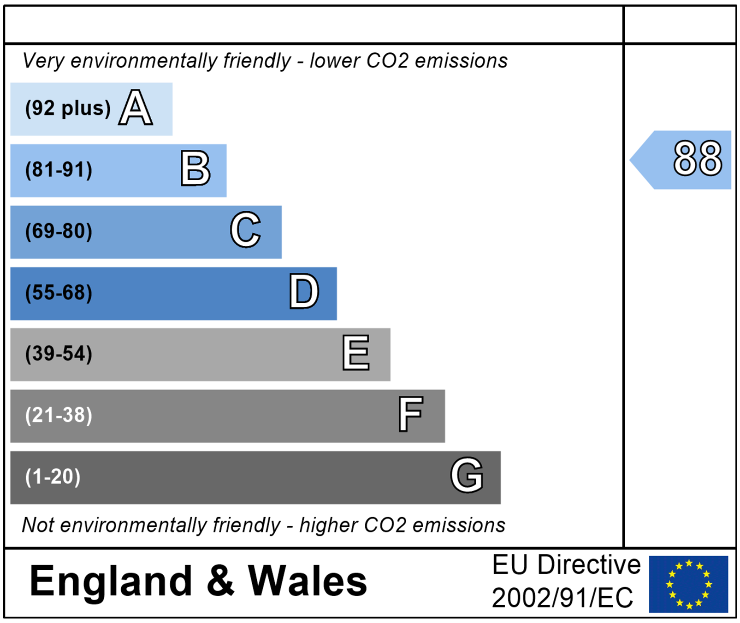
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = $Sum(39)_{1...12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = $Sum(44)_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = $Sum(45)_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1...12}$ | 1090.39 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.52	13.79	11.21	8.49	6.35	5.36	5.79	7.52	10.1	12.82	14.97	15.96	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.36	279.23	269.6	253.8	237.22	221.64	211.75	215.07	223.39	239.32	257.66	271.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.8	376.12	435.89	516.41	583.05	587.72	555.22	492.97	422.48	355.49	319.18	312.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.91	0.76	0.61	0.69	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.42	19.57	19.85	20.27	20.65	20.89	20.97	20.95	20.73	20.25	19.77	19.4	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.54	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.5	18.79	19.2	19.56	19.76	19.8	19.79	19.65	19.19	18.71	18.34	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	18.98	19.26	19.68	20.05	20.26	20.32	20.31	20.13	19.67	19.18	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.53	0.61	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.97	374.31	430.53	495.14	509.28	414.04	292.4	299.33	368.23	348.17	317.72	312.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1205.74	1165.84	1055.08	882.75	682.53	459.47	301.91	316.66	490.86	741.26	991.39	1203.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	652.32	531.91	464.66	279.08	128.89	0	0	0	0	292.46	485.05	662.87	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3497.24 (98)

Space heating requirement in kWh/m²/year 57.9 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	762.51	600.27	615.58	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	622.05	530.05	516.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	761.35	721.91	650.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	100.29	142.74	99.9	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 342.94 (104)

DFEE WorkSheet: New dwelling design stage

Cooled fraction	f C = cooled area ÷ (4) =	1	(105)
Intermittency factor (Table 10b)			

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	25.07	35.69	24.98	0	0	0	0

	Total = Sum(107) =	85.73	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.42	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	59.32	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

TFEE WorkSheet: New dwelling design stage

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = Sum(39)$_{1…12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3	

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = Sum(44)$_{1…12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = Sum(45)$_{1…12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	113.05	98.87	102.03	88.95	85.35	73.65	68.25	78.32	79.25	92.36	100.82	109.48

Output from water heater (annual)$_{1…12}$	1090.39	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.26	24.72	25.51	22.24	21.34	18.41	17.06	19.58	19.81	23.09	25.2	27.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	37.99	36.78	34.28	30.89	28.68	25.57	22.93	26.32	27.52	31.04	35.01	36.79	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	280.37	279.23	269.61	253.8	237.23	221.64	211.76	215.07	223.4	239.33	257.67	271.93	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	329.2	374.93	433.84	513.17	578.8	583.21	551	489.55	420.03	354.06	318.43	312.24	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	1	0.99	0.97	0.9	0.75	0.59	0.67	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.64	19.92	20.32	20.69	20.91	20.98	20.96	20.76	20.3	19.83	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.53	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.61	18.89	19.3	19.64	19.82	19.85	19.85	19.71	19.28	18.81	18.45	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.07	19.35	19.75	20.11	20.3	20.35	20.34	20.18	19.74	19.27	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.69	0.51	0.59	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.41	373.19	428.55	491.54	502.42	403.72	282.92	290.68	363.69	346.7	317.01	311.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1158.59	1120.17	1013.79	848	655.6	441.16	290.24	304.45	471.96	712.46	952.45	1155.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	617.65	501.97	435.41	256.65	113.97	0	0	0	0	272.13	457.51	627.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3283.19 (98)

Space heating requirement in kWh/m²/year 54.36 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	727	572.32	586.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.84	0.9	0.86	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.98	515.47	504.31	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	756.09	716.98	646.3	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	105.92	149.92	105.64	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 361.49 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	26.48	37.48	26.41	0	0	0	0

	Total = Sum(107) =	90.37	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.5	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	55.85	(109)
Target Fabric Energy Efficiency (TFEE)		64.23	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.4	(1a)	x	2.3	(2a)	=	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			4.2	x1/[1/(1.4)+ 0.04]		=	5.57			(27)
Windows Type 3			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.26	26.02	x	0.18	=	4.68			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5362.92 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 55.88 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.98	82.81	82.66	81.91	81.77	81.12	81.12	81	81.37	81.77	82.05	82.35	

Average = Sum(39)$_{1\ldots12}$ /12= 81.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.35	1.35	1.36	1.36	

Average = Sum(40)$_{1\ldots12}$ /12= 1.36 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69	

Total = Sum(44)$_{1\ldots12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8	

Total = Sum(45)$_{1\ldots12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.52	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.07	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37

Output from water heater (annual)$_{1...12}$ | 1453.38 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.87	41.96	43.54	38.3	37	32.3	30.3	34.24	34.5	39.75	42.95	46.47	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	119.58	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	38.81	34.47	28.03	21.22	15.86	13.39	14.47	18.81	25.25	32.06	37.42	39.89	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	259.63	262.33	255.54	241.09	222.84	205.69	194.24	191.54	198.33	212.79	231.03	248.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	48.95	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	64.34	62.45	58.52	53.19	49.73	44.86	40.72	46.03	47.91	53.43	59.66	62.46	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.59	451.05	433.9	407.31	380.24	355.75	341.24	348.19	363.3	390.08	419.92	442.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.62	x	10.63	x	0.63	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	6.62	x	20.32	x	0.63	x	0.7	=	41.11	(74)

North	0.9x	0.77	x	6.62	x	34.53	x	0.63	x	0.7	=	69.86	(74)
North	0.9x	0.77	x	6.62	x	55.46	x	0.63	x	0.7	=	112.21	(74)
North	0.9x	0.77	x	6.62	x	74.72	x	0.63	x	0.7	=	151.16	(74)
North	0.9x	0.77	x	6.62	x	79.99	x	0.63	x	0.7	=	161.82	(74)
North	0.9x	0.77	x	6.62	x	74.68	x	0.63	x	0.7	=	151.08	(74)
North	0.9x	0.77	x	6.62	x	59.25	x	0.63	x	0.7	=	119.86	(74)
North	0.9x	0.77	x	6.62	x	41.52	x	0.63	x	0.7	=	83.99	(74)
North	0.9x	0.77	x	6.62	x	24.19	x	0.63	x	0.7	=	48.94	(74)
North	0.9x	0.77	x	6.62	x	13.12	x	0.63	x	0.7	=	26.54	(74)
North	0.9x	0.77	x	6.62	x	8.86	x	0.63	x	0.7	=	17.93	(74)
Northeast	0.9x	0.77	x	4.2	x	11.28	x	0.63	x	0.7	=	14.48	(75)
Northeast	0.9x	0.77	x	4.2	x	22.97	x	0.63	x	0.7	=	29.48	(75)
Northeast	0.9x	0.77	x	4.2	x	41.38	x	0.63	x	0.7	=	53.11	(75)
Northeast	0.9x	0.77	x	4.2	x	67.96	x	0.63	x	0.7	=	87.23	(75)
Northeast	0.9x	0.77	x	4.2	x	91.35	x	0.63	x	0.7	=	117.25	(75)
Northeast	0.9x	0.77	x	4.2	x	97.38	x	0.63	x	0.7	=	125	(75)
Northeast	0.9x	0.77	x	4.2	x	91.1	x	0.63	x	0.7	=	116.94	(75)
Northeast	0.9x	0.77	x	4.2	x	72.63	x	0.63	x	0.7	=	93.22	(75)
Northeast	0.9x	0.77	x	4.2	x	50.42	x	0.63	x	0.7	=	64.72	(75)
Northeast	0.9x	0.77	x	4.2	x	28.07	x	0.63	x	0.7	=	36.03	(75)
Northeast	0.9x	0.77	x	4.2	x	14.2	x	0.63	x	0.7	=	18.22	(75)
Northeast	0.9x	0.77	x	4.2	x	9.21	x	0.63	x	0.7	=	11.83	(75)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	49.44	96.89	166.29	262.61	345.83	366.08	343.47	277.9	199.09	116.17	61.53	40.82	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	504.03	547.95	600.19	669.92	726.08	721.83	684.71	626.09	562.39	506.26	481.44	483.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.93	0.83	0.66	0.51	0.57	0.82	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.82	20.08	20.45	20.77	20.94	20.99	20.98	20.85	20.45	20	19.65	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.91	0.78	0.56	0.38	0.43	0.73	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.06	18.27	18.65	19.18	19.58	19.77	19.8	19.8	19.69	19.19	18.55	18.03	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.78	18.96	19.29	19.75	20.11	20.29	20.33	20.32	20.2	19.75	19.2	18.75	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.81	19.14	19.6	19.96	20.14	20.18	20.17	20.05	19.6	19.05	18.6	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.78	0.59	0.42	0.48	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	497.14	536.61	576.5	606.96	569.88	427.17	286.67	299.15	422.09	471.44	470.54	477.58	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1189.31	1151.76	1044.81	876.1	675.47	449.49	290.39	305.71	484.42	735.98	980.21	1185.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	514.97	413.38	348.42	193.79	78.56	0	0	0	0	196.82	366.96	526.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2639.8 (98)

Space heating requirement in kWh/m²/year 43.71 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	514.97	413.38	348.42	193.79	78.56	0	0	0	0	196.82	366.96	526.9		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	569.03	456.77	384.99	214.13	86.8	0	0	0	0	217.48	405.48	582.21		

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2916.9 (211)

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Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	147.58	129.47	134.55	118.66	114.86	100.6	94.69	106.57	107.22	123.15	132.68	143.37		
Efficiency of water heater													87.3	(216)
(217)m=	89.77	89.72	89.59	89.26	88.57	87.3	87.3	87.3	87.3	89.24	89.63	89.8		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.4	144.31	150.19	132.94	129.68	115.23	108.46	122.07	122.82	137.99	148.03	159.66		
								Total = Sum(219a)$_{1...12}$ =					1635.79	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2916.9	
Water heating fuel used			1635.79	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.16	(232)
Electricity generated by PVs			-469.22	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	101.51	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	56.93	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	36.16	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	324.49	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)

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SAP rating (Section 12)					81.96	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	630.05	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	353.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =				983.38	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	142.29	(268)
Energy saving/generation technologies						
Item 1			0.519	=	-243.53	(269)
Total CO2, kg/year			sum of (265)…(271) =		921.07	(272)
CO2 emissions per m²			(272) ÷ (4) =		15.25	(273)
EI rating (section 14)					88	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3558.62	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1995.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5554.28	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	841.67	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1440.52	(269)
'Total Primary Energy			sum of (265)…(271) =		5185.68	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		85.86	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 3 - PV

Address : Flat 3, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.4	(1a) x	2.3	(2a) =	138.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	138.92	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			6.54	x1/[1/(1.4)+ 0.04]		=	8.67			(27)
Windows Type 2			4.15	x1/[1/(1.4)+ 0.04]		=	5.5			(27)
Windows Type 3			2.21	x1/[1/(1.4)+ 0.04]		=	2.93			(27)
Floor			60.4	x	0.13	=	7.852			(28)
Walls	41.28	15.1	26.18	x	0.18	=	4.71			(29)
Roof	4.28	0	4.28	x	0.13	=	0.56			(30)
Total area of elements, m²			105.96							(31)
Party wall			31.84	x	0	=	0			(32)
Party ceiling			56.12							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5372.52 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.1 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	27.1	26.94	26.78	26.03	25.89	25.24	25.24	25.12	25.49	25.89	26.18	26.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	79.2	79.04	78.88	78.13	77.99	77.34	77.34	77.22	77.59	77.99	78.27	78.57	

Average = Sum(39)$_{1...12}$ /12= 78.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.31	1.31	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.3	1.3

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.99 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.53 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	89.69	86.42	83.16	79.9	76.64	73.38	73.38	76.64	79.9	83.16	86.42	89.69

Total = Sum(44)$_{1...12}$ = 978.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	133	116.32	120.03	104.65	100.41	86.65	80.29	92.14	93.24	108.66	118.61	128.8

Total = Sum(45)$_{1...12}$ = 1282.81 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.95	17.45	18.01	15.7	15.06	13	12.04	13.82	13.99	16.3	17.79	19.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	45.7	39.78	42.38	39.4	39.05	36.19	37.39	39.05	39.4	42.38	42.62	45.7	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51

Output from water heater (annual)$_{1...12}$ | 1771.87 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	55.65	48.62	50.51	44.65	43.15	37.86	36.05	40.4	40.85	46.72	50.09	54.25	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	99.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.53	13.8	11.22	8.49	6.35	5.36	5.79	7.53	10.11	12.83	14.98	15.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	173.95	175.76	171.21	161.53	149.3	137.81	130.14	128.33	132.88	142.57	154.79	166.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	32.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	-79.72	(71)

Water heating gains (Table 5)

(72)m=	74.8	72.35	67.88	62.01	58	52.58	48.45	54.3	56.74	62.8	69.57	72.92	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	320.18	317.8	306.21	287.92	269.55	251.65	240.27	246.06	255.62	274.09	295.23	311.06	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.54	x	10.63	x	0.63	x	0.7	=	21.25	(74)
North	0.9x	0.77	x	6.54	x	20.32	x	0.63	x	0.7	=	40.62	(74)

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North	0.9x	0.77	x	6.54	x	34.53	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.77	x	6.54	x	55.46	x	0.63	x	0.7	=	110.86	(74)
North	0.9x	0.77	x	6.54	x	74.72	x	0.63	x	0.7	=	149.33	(74)
North	0.9x	0.77	x	6.54	x	79.99	x	0.63	x	0.7	=	159.87	(74)
North	0.9x	0.77	x	6.54	x	74.68	x	0.63	x	0.7	=	149.26	(74)
North	0.9x	0.77	x	6.54	x	59.25	x	0.63	x	0.7	=	118.42	(74)
North	0.9x	0.77	x	6.54	x	41.52	x	0.63	x	0.7	=	82.98	(74)
North	0.9x	0.77	x	6.54	x	24.19	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	6.54	x	13.12	x	0.63	x	0.7	=	26.22	(74)
North	0.9x	0.77	x	6.54	x	8.86	x	0.63	x	0.7	=	17.72	(74)
Northeast	0.9x	0.77	x	4.15	x	11.28	x	0.63	x	0.7	=	14.31	(75)
Northeast	0.9x	0.77	x	4.15	x	22.97	x	0.63	x	0.7	=	29.13	(75)
Northeast	0.9x	0.77	x	4.15	x	41.38	x	0.63	x	0.7	=	52.48	(75)
Northeast	0.9x	0.77	x	4.15	x	67.96	x	0.63	x	0.7	=	86.19	(75)
Northeast	0.9x	0.77	x	4.15	x	91.35	x	0.63	x	0.7	=	115.85	(75)
Northeast	0.9x	0.77	x	4.15	x	97.38	x	0.63	x	0.7	=	123.51	(75)
Northeast	0.9x	0.77	x	4.15	x	91.1	x	0.63	x	0.7	=	115.54	(75)
Northeast	0.9x	0.77	x	4.15	x	72.63	x	0.63	x	0.7	=	92.11	(75)
Northeast	0.9x	0.77	x	4.15	x	50.42	x	0.63	x	0.7	=	63.95	(75)
Northeast	0.9x	0.77	x	4.15	x	28.07	x	0.63	x	0.7	=	35.6	(75)
Northeast	0.9x	0.77	x	4.15	x	14.2	x	0.63	x	0.7	=	18.01	(75)
Northeast	0.9x	0.77	x	4.15	x	9.21	x	0.63	x	0.7	=	11.69	(75)
East	0.9x	0.77	x	2.21	x	19.64	x	0.63	x	0.7	=	13.27	(76)
East	0.9x	0.77	x	2.21	x	38.42	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	2.21	x	63.27	x	0.63	x	0.7	=	42.73	(76)
East	0.9x	0.77	x	2.21	x	92.28	x	0.63	x	0.7	=	62.33	(76)
East	0.9x	0.77	x	2.21	x	113.09	x	0.63	x	0.7	=	76.38	(76)
East	0.9x	0.77	x	2.21	x	115.77	x	0.63	x	0.7	=	78.19	(76)
East	0.9x	0.77	x	2.21	x	110.22	x	0.63	x	0.7	=	74.44	(76)
East	0.9x	0.77	x	2.21	x	94.68	x	0.63	x	0.7	=	63.94	(76)
East	0.9x	0.77	x	2.21	x	73.59	x	0.63	x	0.7	=	49.7	(76)
East	0.9x	0.77	x	2.21	x	45.59	x	0.63	x	0.7	=	30.79	(76)
East	0.9x	0.77	x	2.21	x	24.49	x	0.63	x	0.7	=	16.54	(76)
East	0.9x	0.77	x	2.21	x	16.15	x	0.63	x	0.7	=	10.91	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	48.83	95.69	164.23	259.37	341.57	361.57	339.24	274.47	196.63	114.74	60.76	40.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	369.01	413.5	470.44	547.3	611.12	613.22	579.52	520.53	452.25	388.83	356	351.37	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.96	0.88	0.72	0.57	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.7	19.97	20.37	20.72	20.92	20.98	20.97	20.79	20.35	19.89	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.63	0.43	0.5	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.13	18.53	19.1	19.57	19.81	19.85	19.84	19.68	19.09	18.42	17.89	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.65	18.83	19.18	19.67	20.08	20.3	20.35	20.34	20.18	19.65	19.07	18.62	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.65	18.83	19.18	19.67	20.08	20.3	20.35	20.34	20.18	19.65	19.07	18.62	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.56	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	367.48	410.45	462.22	517.9	517.94	409.01	284.23	293.44	379.11	377.06	353.35	350.21	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1136.74	1101.03	999.85	841.09	653.83	441.12	290.32	304.61	471.53	705.73	937.17	1133.33	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.33	464.07	400	232.7	101.1	0	0	0	0	244.53	420.35	582.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3017.72 (98)

Space heating requirement in kWh/m²/year 49.96 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	572.33	464.07	400	232.7	101.1	0	0	0	0	244.53	420.35	582.64	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	612.77	496.86	428.26	249.14	108.24	0	0	0	0	261.81	450.05	623.81	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3230.97 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
								Total (kWh/year) =Sum(215)$_{1...5,10...12}$=					0	(215)

Water heating

Output from water heater (calculated above)

	178.7	156.1	162.41	144.05	139.47	122.84	117.69	131.19	132.64	151.04	161.23	174.51		
Efficiency of water heater													80.3	(216)
(217)m=	87.77	87.63	87.23	86.25	84.26	80.3	80.3	80.3	80.3	86.26	87.35	87.85		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	203.6	178.15	186.19	167.01	165.53	152.97	146.56	163.38	165.18	175.1	184.57	198.63		
								Total = Sum(219a)$_{1...12}$ =					2086.87	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3230.97	
Water heating fuel used			2086.87	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			274.34	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	697.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	450.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1148.65	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	142.38	(268)
Total CO2, kg/year		sum of (265)…(271) =		1329.96	(272)

TER = 22.02 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:34

Project Information:

Assessed By:	Benjamin Leech (STRO033391)	**Building Type:**	Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE		Total Floor Area: 66.38m²	
Site Reference :	Lawnwood House	**Plot Reference:**	Flat 4 - ASHP
Address :	Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF		

Client Details:

Name:
Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	28.16 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	20.16 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	47.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.48 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: East	8.95m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1\ldots12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1\ldots12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1\ldots12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65

Output from water heater (annual)$_{1...12}$ 2070.66 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.72	85.13	91.21	84.26	84.38	77.99	77.37	81.49	80.28	87.25	89.12	94.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	128.66	126.69	122.59	117.02	113.41	108.32	103.99	109.54	111.51	117.27	123.78	126.7	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	393.89	391.84	379.79	360.53	341.14	322.43	310.28	315.9	325.82	345.28	367.56	384.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447.61	496.93	552.86	612.93	650.47	639.09	611.75	574.86	527.11	469.98	434.55	428.28	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.7	0.53	0.58	0.83	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.96	20.2	20.53	20.8	20.95	20.99	20.98	20.88	20.53	20.12	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.82	0.61	0.41	0.46	0.75	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.4	18.6	18.95	19.42	19.78	19.95	19.97	19.97	19.88	19.43	18.84	18.36	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.26	19.56	19.96	20.28	20.44	20.47	20.47	20.37	19.97	19.46	19.06	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.26	19.56	19.96	20.28	20.44	20.47	20.47	20.37	19.97	19.46	19.06	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.83	0.65	0.47	0.52	0.79	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	445.03	491.8	539.77	572.98	542.22	415.43	286.73	298.78	414.27	448.34	429.71	426.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.69	1097.57	996.75	836.87	647.93	437.65	290.17	304.49	471.56	707.66	936.82	1130.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	511.62	407.08	339.99	190	78.65	0	0	0	0	192.93	365.12	523.58	

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Total per year (kWh/year) = Sum(98)1...5,9...12 =	2608.97	(98)
Space heating requirement in kWh/m²/year	39.3	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	511.62	407.08	339.99	190	78.65	0	0	0	0	192.93	365.12	523.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	204.73	162.9	136.05	76.03	31.47	0	0	0	0	77.2	146.11	209.51		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													1044	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)
Water heating														
Output from water heater (calculated above)	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	114.82	101.43	107.07	96.73	95.33	85.96	83.3	90.38	89.9	100.26	105.08	112.31		
Total = Sum(219a)1...12 =													1182.56	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1044	
Water heating fuel used			1182.56	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	541.84	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

DER WorkSheet: New dwelling design stage

Water heating	(219) x	0.519	=	613.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1155.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1337.95	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.16	(273)
EI rating (section 14)				84	(274)

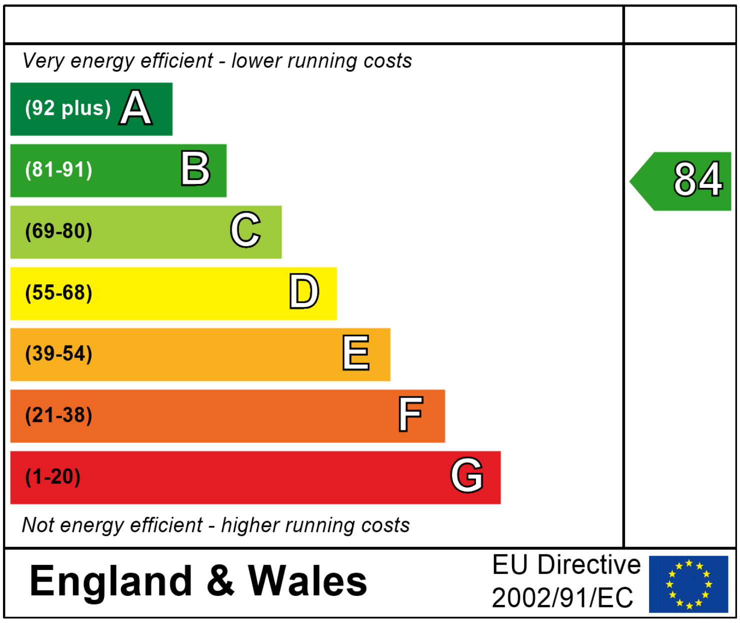
Predicted Energy Assessment

Flat 4 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Date of assessment: Produced by: Total floor area:	Mid floor Flat 20 April 2020 Benjamin Leech 66.38 m²

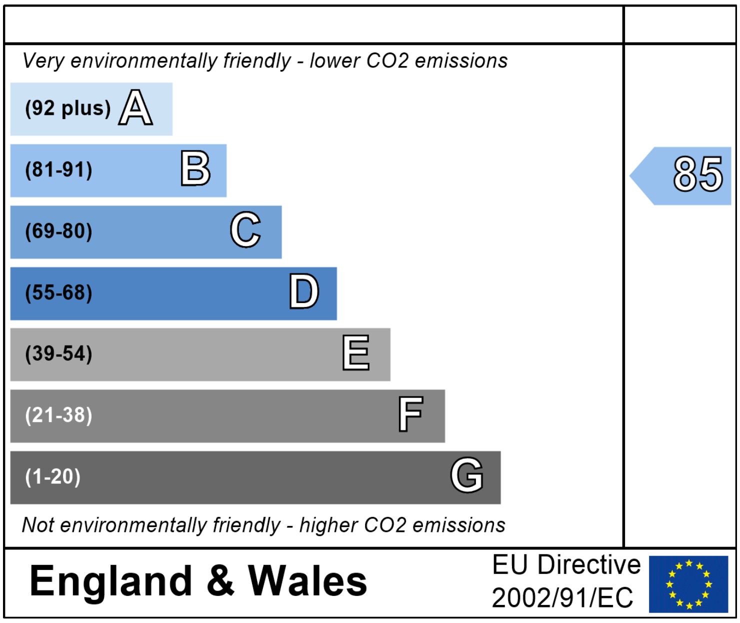
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name: Benjamin Leech — **Stroma Number:** STRO033391
Software Name: Stroma FSAP 2012 — **Software Version:** Version: 1.0.4.25

Property Address: Flat 4 - ASHP

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.6	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.69	19.83	20.09	20.43	20.73	20.93	20.98	20.97	20.82	20.42	19.99	19.67	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.68	0.47	0.54	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	18.9	19.16	19.5	19.78	19.94	19.97	19.97	19.87	19.5	19.07	18.74	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.72	0.54	0.6	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.03	404.08	457.94	505.51	499.84	400.77	283.59	293.29	379.58	374.21	343.07	336.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.27	1104.9	1000.19	836.12	645.63	436.49	289.86	303.96	468.95	706.11	941.32	1140.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	585.71	470.95	403.43	238.04	108.47	0	0	0	0	246.93	430.74	597.77	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = **3082.04** (98)

Space heating requirement in kWh/m²/year **46.43** (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	704.8	554.84	569.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	598.92	507.82	505.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	93.61	140.94	110.04	0	0	0	0	

Total = $Sum(104)_{6...8}$ = **344.59** (104)

Cooled fraction — f C = cooled area ÷ (4) = **1** (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = **0** (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	23.4	35.23	27.51	0	0	0	0

Total = $Sum(107)_{6...8}$ = **86.15** (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = **1.3** (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = **47.73** (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1\ldots12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1		

Average = Sum(40)$_{1\ldots12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1\ldots12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1\ldots12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.89	20.14	20.47	20.77	20.94	20.99	20.98	20.85	20.46	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.46	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	18.99	19.24	19.58	19.85	19.99	20.01	20.01	19.92	19.57	19.15	18.84	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.88	0.71	0.52	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.05	404.09	457.81	504.41	495.41	391.95	274.86	284.98	375.42	373.88	343.08	336.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1101.95	1065.89	964.95	806.54	622.69	420.67	279.51	293.12	452.45	681.32	907.94	1099.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.7	444.73	377.32	217.53	94.7	0	0	0	0	228.73	406.7	567.58	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2892.98 (98)

Space heating requirement in kWh/m²/year 43.58 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	675.8	532.01	545.61	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	588.38	494.95	494.32	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	101.19	150.51	118.26	0	0	0	0

Total = $Sum(104)_{6...8}$ = 369.96 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	25.3	37.63	29.56	0	0	0	0

Total = $Sum(107)_{6...8}$ = 92.49 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.39 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 44.98 (109)

Target Fabric Energy Efficiency (TFEE) 51.72 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1\ldots12}$ /12= 75.65 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	

Output from water heater (annual)$_{1...12}$ 2070.66 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.72	85.13	91.21	84.26	84.38	77.99	77.37	81.49	80.28	87.25	89.12	94.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.49	40.41	32.86	24.88	18.6	15.7	16.96	22.05	29.6	37.58	43.86	46.76	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	281.65	284.57	277.21	261.53	241.74	223.13	210.71	207.78	215.15	230.83	250.62	269.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)
Water heating gains (Table 5)													
(72)m=	128.66	126.69	122.59	117.02	113.41	108.32	103.99	109.54	111.51	117.27	123.78	126.7	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	551.99	547.86	528.85	499.62	469.93	443.34	427.85	435.56	452.44	481.87	514.45	538.87	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	605.71	652.95	701.92	752.03	779.27	760	729.33	694.52	653.73	606.56	581.43	583.04	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.79	0.61	0.45	0.49	0.73	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.04	20.16	20.39	20.67	20.88	20.97	21	20.99	20.94	20.68	20.31	20.01	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.88	0.73	0.52	0.35	0.38	0.64	0.89	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.89	19.21	19.6	19.86	19.96	19.98	19.98	19.93	19.62	19.11	18.67	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.36	19.51	19.79	20.12	20.35	20.46	20.47	20.47	20.42	20.14	19.7	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.36	19.51	19.79	20.12	20.35	20.46	20.47	20.47	20.42	20.14	19.7	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.88	0.75	0.56	0.4	0.44	0.68	0.9	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	594.06	633.88	663.73	662.69	587.76	427.34	288.82	302.34	445.41	544.74	561.93	573.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1152.91	1116.89	1013.64	848.87	653.69	439.06	290.42	304.91	475.36	720.56	954.68	1149.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	415.78	324.58	260.33	134.05	49.05	0	0	0	0	130.82	282.78	428.79	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2026.17	(98)
Space heating requirement in kWh/m²/year	30.52	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	415.78	324.58	260.33	134.05	49.05	0	0	0	0	130.82	282.78	428.79		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	166.38	129.89	104.17	53.64	19.63	0	0	0	0	52.35	113.16	171.58		(211)
Total (kWh/year) = $Sum(211)_{1...5,10...12}$ =													810.79	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) = $Sum(215)_{1...5,10...12}$ =													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	114.82	101.43	107.07	96.73	95.33	85.96	83.3	90.38	89.9	100.26	105.08	112.31		
Total = $Sum(219a)_{1...12}$ =													1182.56	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			810.79	
Water heating fuel used			1182.56	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			321.37	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	106.94	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)

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Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	155.98	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.39	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	309.27	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.17	(257)
SAP rating (Section 12)		83.73	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	420.8	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	613.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1034.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1216.91	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.33	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2489.13	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3630.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6119.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	986.62	(268)
'Total Primary Energy		sum of (265)…(271) =		7198.3	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		108.44	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1…12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	
											Total = Sum(44)$_{1…12}$ =	1024.61	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	
											Total = Sum(45)$_{1…12}$ =	1343.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64

Output from water heater (annual)$_{1...12}$ 1952.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.71	77.9	83.19	76.5	76.36	70.23	69.36	73.48	72.53	79.23	81.36	86.25	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	117.89	115.92	111.82	106.25	102.64	97.55	93.22	98.76	100.73	106.5	113	115.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.12	381.07	369.02	349.76	330.37	311.65	299.51	305.13	315.05	334.51	356.79	373.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	436.84	486.16	542.09	602.16	639.7	628.31	600.98	564.09	516.33	459.21	423.78	417.51	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.52	0.57	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	20	20.25	20.56	20.82	20.96	20.99	20.99	20.9	20.56	20.16	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.6	0.41	0.46	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.5	18.69	19.04	19.5	19.84	19.99	20.01	20.01	19.93	19.5	18.92	18.46	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.33	19.63	20.02	20.32	20.46	20.49	20.49	20.4	20.02	19.52	19.14	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.33	19.63	20.02	20.32	20.46	20.49	20.49	20.4	20.02	19.52	19.14	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.83	0.64	0.46	0.51	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	434.56	481.49	529.7	562.79	530.61	403.11	277.05	288.94	403.91	438.62	419.43	415.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1092.44	1058.53	961.27	806.81	624.42	421.51	279.72	293.48	454.46	682.22	903.17	1089.54	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	489.46	387.77	321.09	175.7	69.79	0	0	0	0	181.24	348.29	501.28	(98)

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2474.63	(98)
Space heating requirement in kWh/m²/year	37.28	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	489.46	387.77	321.09	175.7	69.79	0	0	0	0	181.24	348.29	501.28		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	523.49	414.73	343.41	187.91	74.64	0	0	0	0	193.84	372.5	536.13		(211)
Total (kWh/year) =$Sum(211)_{1...5,10...12}$=													2646.66	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =$Sum(215)_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64		
Efficiency of water heater													79.8	(216)
(217)m=	87.22	86.97	86.38	85.07	82.81	79.8	79.8	79.8	79.8	85.06	86.63	87.32		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	219.03	193.82	205.44	187.7	189.47	176.47	170.22	185.76	185.11	194.63	201.2	213.73		
Total = $Sum(219a)_{1...12}$ =													2322.57	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2646.66	
Water heating fuel used			2322.57	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	571.68	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	501.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1073.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =			1279.07	(272)

TER = 28.16 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:24

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 66.38m²

Site Reference : Lawnwood House **Plot Reference:** Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	28.16 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.66 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	47.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.48 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	8.95m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1\ldots12}$ /12= 75.65 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	

Output from water heater (annual)$_{1...12}$ 2070.66 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.72	85.13	91.21	84.26	84.38	77.99	77.37	81.49	80.28	87.25	89.12	94.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	128.66	126.69	122.59	117.02	113.41	108.32	103.99	109.54	111.51	117.27	123.78	126.7	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	393.89	391.84	379.79	360.53	341.14	322.43	310.28	315.9	325.82	345.28	367.56	384.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447.61	496.93	552.86	612.93	650.47	639.09	611.75	574.86	527.11	469.98	434.55	428.28	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.7	0.53	0.58	0.83	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.96	20.2	20.53	20.8	20.95	20.99	20.98	20.88	20.53	20.12	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.82	0.61	0.41	0.46	0.75	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.4	18.6	18.95	19.42	19.78	19.95	19.97	19.97	19.88	19.43	18.84	18.36	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.26	19.56	19.96	20.28	20.44	20.47	20.47	20.37	19.97	19.46	19.06	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.26	19.56	19.96	20.28	20.44	20.47	20.47	20.37	19.97	19.46	19.06	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.83	0.65	0.47	0.52	0.79	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	445.03	491.8	539.77	572.98	542.22	415.43	286.73	298.78	414.27	448.34	429.71	426.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1132.69	1097.57	996.75	836.87	647.93	437.65	290.17	304.49	471.56	707.66	936.82	1130.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	511.62	407.08	339.99	190	78.65	0	0	0	0	192.93	365.12	523.58	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2608.97	(98)
Space heating requirement in kWh/m²/year	39.3	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	511.62	407.08	339.99	190	78.65	0	0	0	0	192.93	365.12	523.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	204.73	162.9	136.05	76.03	31.47	0	0	0	0	77.2	146.11	209.51		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1044	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	114.82	101.43	107.07	96.73	95.33	85.96	83.3	90.38	89.9	100.26	105.08	112.31		
Total = Sum(219a)$_{1...12}$ =													1182.56	(219)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		1044	
Water heating fuel used		1182.56	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		30	(231)
Electricity for lighting		321.37	(232)
Electricity generated by PVs		-703.46	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	541.84	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	613.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1155.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-365.09	(269)
Total CO2, kg/year	sum of (265)…(271) =			972.85	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.66	(273)
EI rating (section 14)				88	(274)

Predicted Energy Assessment

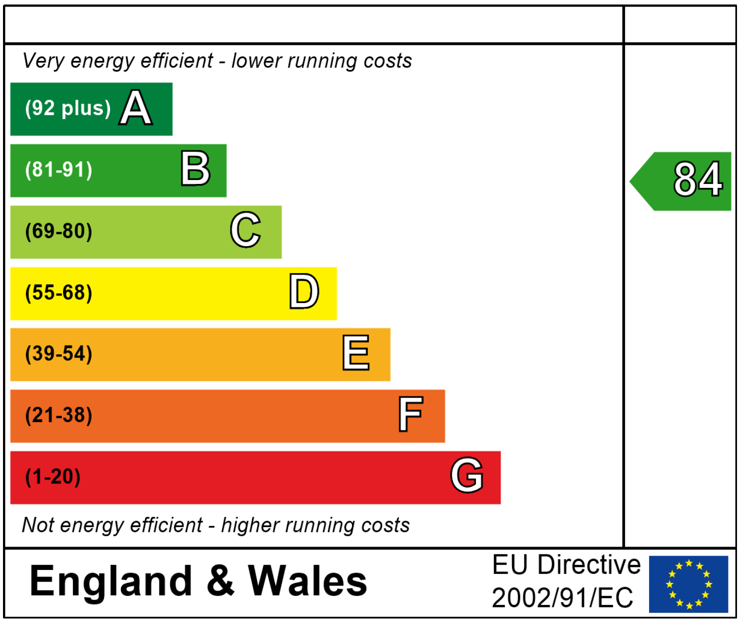
Flat 4
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Mid floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	66.38 m²

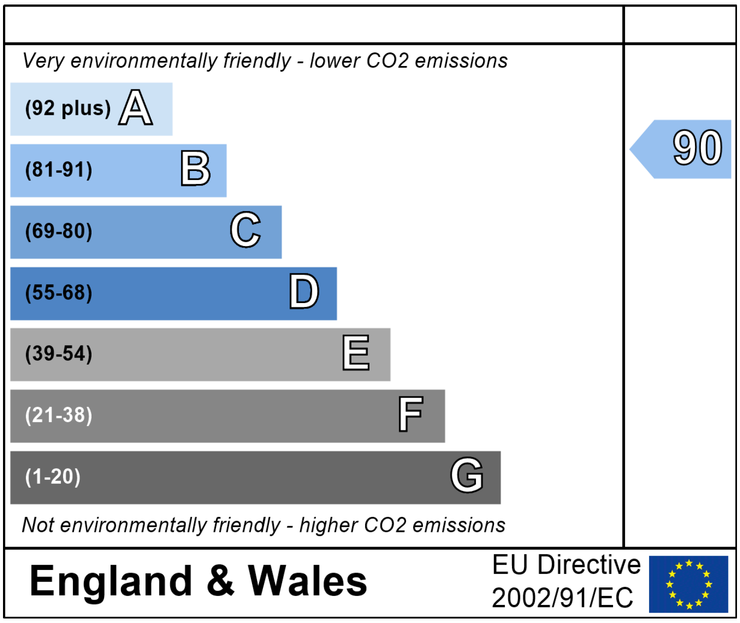
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.6	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.69	19.83	20.09	20.43	20.73	20.93	20.98	20.97	20.82	20.42	19.99	19.67	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.68	0.47	0.54	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	18.9	19.16	19.5	19.78	19.94	19.97	19.97	19.87	19.5	19.07	18.74	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.72	0.54	0.6	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.03	404.08	457.94	505.51	499.84	400.77	283.59	293.29	379.58	374.21	343.07	336.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.27	1104.9	1000.19	836.12	645.63	436.49	289.86	303.96	468.95	706.11	941.32	1140.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	585.71	470.95	403.43	238.04	108.47	0	0	0	0	246.93	430.74	597.77	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3082.04 (98)

Space heating requirement in kWh/m²/year 46.43 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	704.8	554.84	569.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	598.92	507.82	505.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	93.61	140.94	110.04	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 344.59 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	23.4	35.23	27.51	0	0	0	0

Total = Sum(107)$_{6...8}$ = 86.15 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.3 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 47.73 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1\ldots12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.89	20.14	20.47	20.77	20.94	20.99	20.98	20.85	20.46	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.46	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	18.99	19.24	19.58	19.85	19.99	20.01	20.01	19.92	19.57	19.15	18.84	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.88	0.71	0.52	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.05	404.09	457.81	504.41	495.41	391.95	274.86	284.98	375.42	373.88	343.08	336.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1101.95	1065.89	964.95	806.54	622.69	420.67	279.51	293.12	452.45	681.32	907.94	1099.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.7	444.73	377.32	217.53	94.7	0	0	0	0	228.73	406.7	567.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2892.98	(98)
Space heating requirement in kWh/m²/year	43.58	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	675.8	532.01	545.61	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	588.38	494.95	494.32	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	101.19	150.51	118.26	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	369.96	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	25.3	37.63	29.56	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	92.49	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.39	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	44.98	(109)
Target Fabric Energy Efficiency (TFEE)		51.72	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = $Sum(39)_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1...12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	
										Total = Sum(44)$_{1...12}$ =		1024.61	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	
										Total = Sum(45)$_{1...12}$ =		1343.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65	

Output from water heater (annual)$_{1...12}$ 2070.66 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	95.72	85.13	91.21	84.26	84.38	77.99	77.37	81.49	80.28	87.25	89.12	94.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.49	40.41	32.86	24.88	18.6	15.7	16.96	22.05	29.6	37.58	43.86	46.76	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	281.65	284.57	277.21	261.53	241.74	223.13	210.71	207.78	215.15	230.83	250.62	269.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)
Water heating gains (Table 5)													
(72)m=	128.66	126.69	122.59	117.02	113.41	108.32	103.99	109.54	111.51	117.27	123.78	126.7	(72)
Total internal gains =							(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m						
(73)m=	551.99	547.86	528.85	499.62	469.93	443.34	427.85	435.56	452.44	481.87	514.45	538.87	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	605.71	652.95	701.92	752.03	779.27	760	729.33	694.52	653.73	606.56	581.43	583.04	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.79	0.61	0.45	0.49	0.73	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.04	20.16	20.39	20.67	20.88	20.97	21	20.99	20.94	20.68	20.31	20.01	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.88	0.73	0.52	0.35	0.38	0.64	0.89	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.71	18.89	19.21	19.6	19.86	19.96	19.98	19.98	19.93	19.62	19.11	18.67	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.36	19.51	19.79	20.12	20.35	20.46	20.47	20.47	20.42	20.14	19.7	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.36	19.51	19.79	20.12	20.35	20.46	20.47	20.47	20.42	20.14	19.7	19.32	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.88	0.75	0.56	0.4	0.44	0.68	0.9	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	594.06	633.88	663.73	662.69	587.76	427.34	288.82	302.34	445.41	544.74	561.93	573.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1152.91	1116.89	1013.64	848.87	653.69	439.06	290.42	304.91	475.36	720.56	954.68	1149.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	415.78	324.58	260.33	134.05	49.05	0	0	0	0	130.82	282.78	428.79	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2026.17	(98)
Space heating requirement in kWh/m²/year	30.52	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	415.78	324.58	260.33	134.05	49.05	0	0	0	0	130.82	282.78	428.79		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	166.38	129.89	104.17	53.64	19.63	0	0	0	0	52.35	113.16	171.58		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													810.79	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	201.05	177.61	187.47	169.37	166.92	150.52	145.85	158.26	157.42	175.56	183.99	196.65		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	114.82	101.43	107.07	96.73	95.33	85.96	83.3	90.38	89.9	100.26	105.08	112.31		
Total = Sum(219a)$_{1...12}$ =													1182.56	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			810.79	
Water heating fuel used			1182.56	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			321.37	(232)
Electricity generated by PVs			-703.46	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	106.94	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	155.98 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96 (249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.39 (250)
Additional standing charges (Table 12)				0 (251)
	one of (233) to (235) x)	13.19	x 0.01 =	0 (252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	309.27 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.17 (257)
SAP rating (Section 12)		83.73 (258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211) x	0.519	=	420.8 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	613.75 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1034.55 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57 (267)
Electricity for lighting	(232) x	0.519	=	166.79 (268)
Energy saving/generation technologies Item 1		0.519	=	-365.09 (269)
Total CO2, kg/year		sum of (265)…(271) =		851.82 (272)
CO2 emissions per m²		(272) ÷ (4) =		12.83 (273)
EI rating (section 14)				90 (274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year
Space heating (main system 1)	(211) x	3.07	=	2489.13 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	3630.45 (264)
Space and water heating	(261) + (262) + (263) + (264) =			6119.59 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1 (267)

Electricity for lighting	(232) x	0	=	986.62	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-2159.61	(269)
'Total Primary Energy	sum of (265)…(271) =			5038.69	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			75.91	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - ASHP + PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1…12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	

Average = Sum(40)1…12 /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	

Total = Sum(44)1…12 = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	

Total = Sum(45)1…12 = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64	

Output from water heater (annual)$_{1...12}$ 1952.71 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	87.71	77.9	83.19	76.5	76.36	70.23	69.36	73.48	72.53	79.23	81.36	86.25	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	117.89	115.92	111.82	106.25	102.64	97.55	93.22	98.76	100.73	106.5	113	115.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	383.12	381.07	369.02	349.76	330.37	311.65	299.51	305.13	315.05	334.51	356.79	373.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	436.84	486.16	542.09	602.16	639.7	628.31	600.98	564.09	516.33	459.21	423.78	417.51	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.52	0.57	0.82	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	20	20.25	20.56	20.82	20.96	20.99	20.99	20.9	20.56	20.16	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.6	0.41	0.46	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.5	18.69	19.04	19.5	19.84	19.99	20.01	20.01	19.93	19.5	18.92	18.46	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.17	19.33	19.63	20.02	20.32	20.46	20.49	20.49	20.4	20.02	19.52	19.14	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.33	19.63	20.02	20.32	20.46	20.49	20.49	20.4	20.02	19.52	19.14	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.83	0.64	0.46	0.51	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	434.56	481.49	529.7	562.79	530.61	403.11	277.05	288.94	403.91	438.62	419.43	415.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1092.44	1058.53	961.27	806.81	624.42	421.51	279.72	293.48	454.46	682.22	903.17	1089.54	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	489.46	387.77	321.09	175.7	69.79	0	0	0	0	181.24	348.29	501.28	

TER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2474.63	(98)
Space heating requirement in kWh/m²/year	37.28	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	489.46	387.77	321.09	175.7	69.79	0	0	0	0	181.24	348.29	501.28		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	523.49	414.73	343.41	187.91	74.64	0	0	0	0	193.84	372.5	536.13		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2646.66	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	191.03	168.56	177.45	159.67	156.91	140.82	135.83	148.24	147.72	165.54	174.29	186.64		
Efficiency of water heater													79.8	(216)
(217)m=	87.22	86.97	86.38	85.07	82.81	79.8	79.8	79.8	79.8	85.06	86.63	87.32		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	219.03	193.82	205.44	187.7	189.47	176.47	170.22	185.76	185.11	194.63	201.2	213.73		
Total = Sum(219a)$_{1...12}$ =													2322.57	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2646.66	
Water heating fuel used			2322.57	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	571.68	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1073.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1279.07	(272)

TER =	28.16	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:44

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 66.38m²

Site Reference : Lawnwood House **Plot Reference:** Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	19.46 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	18.76 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	47.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.48 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: East	$8.95m^2$
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	$0 W/m^2K$

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.61	13.17	14.55	14.03	14.47	13.97	14.41	14.45	14	14.51	14.1	14.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	

Output from water heater (annual)$_{1...12}$ 1514.3 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	49.96	43.8	45.43	39.95	38.58	33.66	31.56	35.7	35.97	41.47	44.83	48.5	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	67.16	65.18	61.07	55.48	51.86	46.76	42.42	47.98	49.95	55.73	62.26	65.19	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.39	330.33	318.27	298.99	279.59	260.86	248.71	254.34	264.27	283.75	306.05	322.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	386.11	435.42	491.33	551.39	588.92	577.52	550.18	513.3	465.55	408.44	373.03	366.78	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	19.87	20.12	20.46	20.75	20.93	20.99	20.98	20.84	20.45	20.03	19.71	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.51	0.81	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.27	18.47	18.84	19.32	19.72	19.93	19.97	19.97	19.84	19.33	18.71	18.24	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.99	19.16	19.47	19.88	20.23	20.42	20.47	20.46	20.33	19.88	19.36	18.96	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	19.01	19.32	19.73	20.08	20.27	20.32	20.31	20.18	19.73	19.21	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.69	0.5	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	384.86	432.67	483.53	524.67	508.64	397.35	274.3	285.41	385.54	396.21	370.68	365.85	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1113.1	1078.13	977.71	819.18	632.75	425.18	278.66	292.82	457.27	689.4	917.55	1110.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	541.81	433.75	367.67	212.05	92.34	0	0	0	0	218.13	393.74	554.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2813.53 (98)

Space heating requirement in kWh/m²/year 42.39 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	541.81	433.75	367.67	212.05	92.34	0	0	0	0	218.13	393.74	554.03		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	598.69	479.28	406.27	234.31	102.03	0	0	0	0	241.03	435.08	612.19		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3108.88	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49		
Efficiency of water heater													87.3	(216)
(217)m=	89.77	89.72	89.59	89.29	88.67	87.3	87.3	87.3	87.3	89.29	89.65	89.8		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	171.43	150.46	156.54	138.45	134.92	119.94	112.83	127.08	127.89	143.7	154.29	166.47		
Total = Sum(219a)$_{1...12}$ =													1704	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3108.88	
Water heating fuel used			1704	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	671.52	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	368.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1245.3	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.76	(273)
EI rating (section 14)				85	(274)

Predicted Energy Assessment

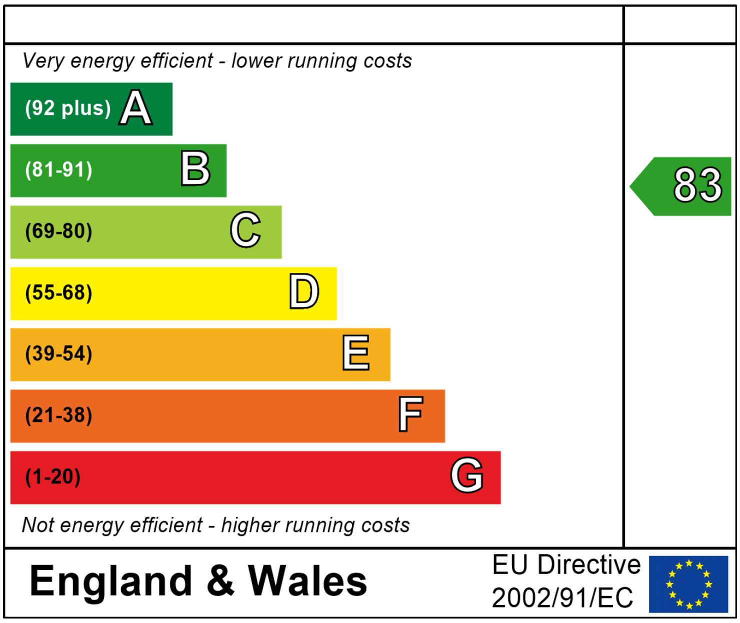
Flat 4
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Mid floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	66.38 m²

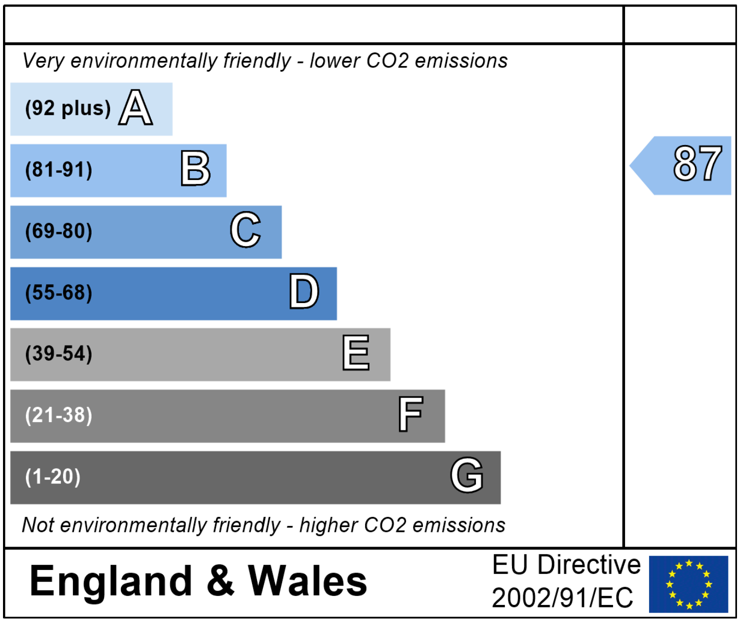
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1\ldots12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1\ldots12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1\ldots12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)
Water heating gains (Table 5)													
(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.6	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.69	19.83	20.09	20.43	20.73	20.93	20.98	20.97	20.82	20.42	19.99	19.67	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.68	0.47	0.54	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	18.9	19.16	19.5	19.78	19.94	19.97	19.97	19.87	19.5	19.07	18.74	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.72	0.54	0.6	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.03	404.08	457.94	505.51	499.84	400.77	283.59	293.29	379.58	374.21	343.07	336.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.27	1104.9	1000.19	836.12	645.63	436.49	289.86	303.96	468.95	706.11	941.32	1140.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	585.71	470.95	403.43	238.04	108.47	0	0	0	0	246.93	430.74	597.77	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3082.04 (98)

Space heating requirement in kWh/m²/year 46.43 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	704.8	554.84	569.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	598.92	507.82	505.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	93.61	140.94	110.04	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 344.59 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	23.4	35.23	27.51	0	0	0	0

Total = Sum(107)$_{6...8}$ = 86.15 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.3 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 47.73 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1…12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	

Average = Sum(40)$_{1\ldots12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	

Total = Sum(44)$_{1\ldots12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	

Total = Sum(45)$_{1\ldots12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.89	20.14	20.47	20.77	20.94	20.99	20.98	20.85	20.46	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.46	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	18.99	19.24	19.58	19.85	19.99	20.01	20.01	19.92	19.57	19.15	18.84	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.88	0.71	0.52	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.05	404.09	457.81	504.41	495.41	391.95	274.86	284.98	375.42	373.88	343.08	336.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1101.95	1065.89	964.95	806.54	622.69	420.67	279.51	293.12	452.45	681.32	907.94	1099.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.7	444.73	377.32	217.53	94.7	0	0	0	0	228.73	406.7	567.58	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2892.98	(98)
Space heating requirement in kWh/m²/year	43.58	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)														
(100)m=	0	0	0	0	0	675.8	532.01	545.61	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	588.38	494.95	494.32	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m														
(104)m=	0	0	0	0	0	101.19	150.51	118.26	0	0	0	0		
									Total = Sum(104)$_{6...8}$			=	369.96	(104)
Cooled fraction									f C = cooled area ÷ (4) =				1	(105)
Intermittency factor (Table 10b)														
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		
									Total = Sum(104)$_{6...8}$			=	0	(106)
Space cooling requirement for month = (104)m × (105) × (106)m														
(107)m=	0	0	0	0	0	25.3	37.63	29.56	0	0	0	0		
									Total = Sum(107)$_{6...8}$			=	92.49	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =				1.39	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	44.98	(109)
Target Fabric Energy Efficiency (TFEE)		51.72	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1\ldots12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.16 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.61	13.17	14.55	14.03	14.47	13.97	14.41	14.45	14	14.51	14.1	14.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	

Output from water heater (annual)$_{1...12}$ 1514.3 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	49.96	43.8	45.43	39.95	38.58	33.66	31.56	35.7	35.97	41.47	44.83	48.5	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	45.49	40.41	32.86	24.88	18.6	15.7	16.96	22.05	29.6	37.58	43.86	46.76	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	281.65	284.57	277.21	261.53	241.74	223.13	210.71	207.78	215.15	230.83	250.62	269.22	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	67.16	65.18	61.07	55.48	51.86	46.76	42.42	47.98	49.95	55.73	62.26	65.19	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	490.49	486.34	467.32	438.08	408.38	381.78	366.28	374	390.89	420.33	452.93	477.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	544.21	591.43	640.39	690.49	717.72	698.44	667.76	632.96	592.17	545.03	519.91	521.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.49	0.53	0.78	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.08	20.32	20.61	20.84	20.96	20.99	20.99	20.92	20.62	20.23	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.9	0.77	0.56	0.38	0.42	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.78	19.11	19.53	19.82	19.95	19.97	19.97	19.91	19.54	19	18.55	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.26	19.42	19.7	20.06	20.32	20.45	20.47	20.47	20.4	20.07	19.6	19.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.27	19.55	19.91	20.17	20.3	20.32	20.32	20.25	19.92	19.45	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.9	0.78	0.59	0.42	0.46	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	536.98	578.92	613.67	623.14	562.62	412.98	277.16	290.37	425.51	502.34	507.74	515.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.7	1098	995.52	832.63	639.95	427.22	279.07	293.51	462.56	703.88	936.05	1130.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	443.96	348.82	284.1	150.84	57.53	0	0	0	0	149.94	308.39	457.47	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2201.05	(98)
Space heating requirement in kWh/m²/year	33.16	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	443.96	348.82	284.1	150.84	57.53	0	0	0	0	149.94	308.39	457.47		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	490.56	385.44	313.92	166.67	63.57	0	0	0	0	165.68	340.76	505.49		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2432.09	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49		
Efficiency of water heater													87.3	(216)
(217)m=	89.65	89.58	89.42	89.03	88.31	87.3	87.3	87.3	87.3	89	89.48	89.69		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	171.65	150.69	156.85	138.86	135.46	119.94	112.83	127.08	127.89	144.17	154.56	166.67		
Total = Sum(219a)$_{1...12}$ =													1706.66	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2432.09	
Water heating fuel used			1706.66	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	84.64	(240)

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Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	59.39	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.39	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	316.31	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.19	(257)
SAP rating (Section 12)		83.36	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	525.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	368.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			893.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1099.69	(272)
CO2 emissions per m²		(272) ÷ (4) =		16.57	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2967.16	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2082.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5049.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	986.62	(268)
'Total Primary Energy		sum of (265)…(271) =		6266.15	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		94.4	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - Baseline

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.38	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6036.77	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1…12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	47.86	41.66	44.38	41.27	40.9	37.9	39.16	40.9	41.27	44.38	44.63	47.86	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75	

Output from water heater (annual)$_{1…12}$ 1855.6 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	58.28	50.92	52.89	46.76	45.19	39.65	37.75	42.31	42.78	48.93	52.46	56.82	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	78.33	75.77	71.09	64.94	60.74	55.06	50.74	56.87	59.42	65.77	72.86	76.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	343.56	340.93	328.29	308.44	288.47	269.17	257.02	263.23	273.74	293.78	316.65	333.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	397.28	446.02	501.36	560.85	597.8	585.83	558.5	522.19	475.02	418.48	383.63	377.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.89	0.72	0.55	0.61	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.95	20.19	20.52	20.79	20.95	20.99	20.98	20.87	20.51	20.1	19.79	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.64	0.44	0.49	0.79	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.41	18.61	18.97	19.43	19.8	19.98	20.01	20.01	19.91	19.43	18.84	18.38	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.26	19.56	19.96	20.29	20.45	20.49	20.48	20.38	19.96	19.46	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.26	19.56	19.96	20.29	20.45	20.49	20.48	20.38	19.96	19.46	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.49	0.55	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	395.91	443.03	492.9	531.9	511.73	397.15	275.91	286.98	389.23	405.04	381.05	376.94	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1087.4	1053.5	956.44	802.79	622.06	420.82	279.59	293.25	452.69	677.84	898.18	1084.51	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	514.47	410.24	344.87	195.04	82.09	0	0	0	0	202.97	372.34	526.43	

TER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2648.44	(98)
Space heating requirement in kWh/m²/year	39.9	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	514.47	410.24	344.87	195.04	82.09	0	0	0	0	202.97	372.34	526.43		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	550.82	439.22	369.24	208.82	87.89	0	0	0	0	217.31	398.65	563.63		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2835.59	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75		
Efficiency of water heater													80.3	(216)
(217)m=	87.47	87.27	86.79	85.7	83.66	80.3	80.3	80.3	80.3	85.68	86.99	87.56		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	213.97	187.32	195.97	176.03	174.58	160.2	153.48	171.1	172.99	184.61	194.11	208.71		
Total = Sum(219a)$_{1...12}$ =													2193.07	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2835.59	
Water heating fuel used			2193.07	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	612.49	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	473.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1086.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1291.91	(272)

TER = 19.46 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:14

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 66.38m²

Site Reference : Lawnwood House **Plot Reference:** Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	19.46 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.72 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	47.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.48 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation			
Hot water Storage:	No cylinder		
6 Controls			
Space heating controls	TTZC by plumbing and electrical services		OK
Hot water controls:	No cylinder thermostat		
	No cylinder		
Boiler interlock:	Yes		OK
7 Low energy lights			
Percentage of fixed lights with low-energy fittings		100.0%	
Minimum		75.0%	OK
8 Mechanical ventilation			
Not applicable			
9 Summertime temperature			
Overheating risk (Severn valley):		Slight	OK
Based on:			
Overshading:		Average or unknown	
Windows facing: East		8.95m²	
Ventilation rate:		2.00	
Blinds/curtains:		Dark-coloured curtain or roller blind	
		Closed 100% of daylight hours	
10 Key features			
Party Walls U-value		0 W/m²K	
Photovoltaic array			

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	
									Total = Sum(44)$_{1…12}$ =			1024.61	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	
									Total = Sum(45)$_{1…12}$ =			1343.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.61	13.17	14.55	14.03	14.47	13.97	14.41	14.45	14	14.51	14.1	14.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	

Output from water heater (annual)$_{1...12}$ 1514.3 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	49.96	43.8	45.43	39.95	38.58	33.66	31.56	35.7	35.97	41.47	44.83	48.5	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	67.16	65.18	61.07	55.48	51.86	46.76	42.42	47.98	49.95	55.73	62.26	65.19	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.39	330.33	318.27	298.99	279.59	260.86	248.71	254.34	264.27	283.75	306.05	322.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	386.11	435.42	491.33	551.39	588.92	577.52	550.18	513.3	465.55	408.44	373.03	366.78	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	19.87	20.12	20.46	20.75	20.93	20.99	20.98	20.84	20.45	20.03	19.71	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.51	0.81	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.27	18.47	18.84	19.32	19.72	19.93	19.97	19.97	19.84	19.33	18.71	18.24	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.99	19.16	19.47	19.88	20.23	20.42	20.47	20.46	20.33	19.88	19.36	18.96	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	19.01	19.32	19.73	20.08	20.27	20.32	20.31	20.18	19.73	19.21	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.69	0.5	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	384.86	432.67	483.53	524.67	508.64	397.35	274.3	285.41	385.54	396.21	370.68	365.85	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1113.1	1078.13	977.71	819.18	632.75	425.18	278.66	292.82	457.27	689.4	917.55	1110.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	541.81	433.75	367.67	212.05	92.34	0	0	0	0	218.13	393.74	554.03	(98)

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2813.53	(98)
Space heating requirement in kWh/m²/year	42.39	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	541.81	433.75	367.67	212.05	92.34	0	0	0	0	218.13	393.74	554.03		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	598.69	479.28	406.27	234.31	102.03	0	0	0	0	241.03	435.08	612.19		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3108.88	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49		
Efficiency of water heater													87.3	(216)
(217)m=	89.77	89.72	89.59	89.29	88.67	87.3	87.3	87.3	87.3	89.29	89.65	89.8		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	171.43	150.46	156.54	138.45	134.92	119.94	112.83	127.08	127.89	143.7	154.29	166.47		
Total = Sum(219a)$_{1...12}$ =													1704	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3108.88	
Water heating fuel used			1704	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)
Electricity generated by PVs			-516.37	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	671.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	368.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-268	(269)
Total CO2, kg/year	sum of (265)…(271) =			977.3	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.72	(273)
EI rating (section 14)				88	(274)

Predicted Energy Assessment

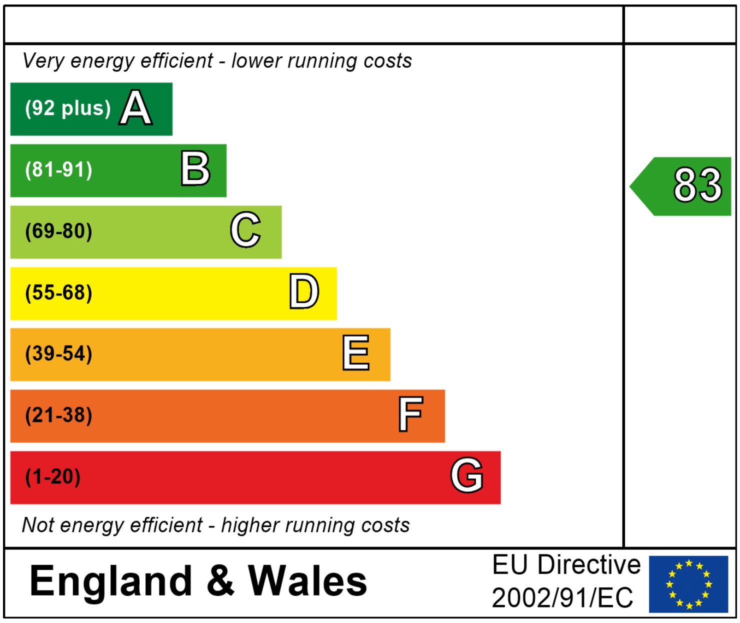
Flat 4
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Mid floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	66.38 m²

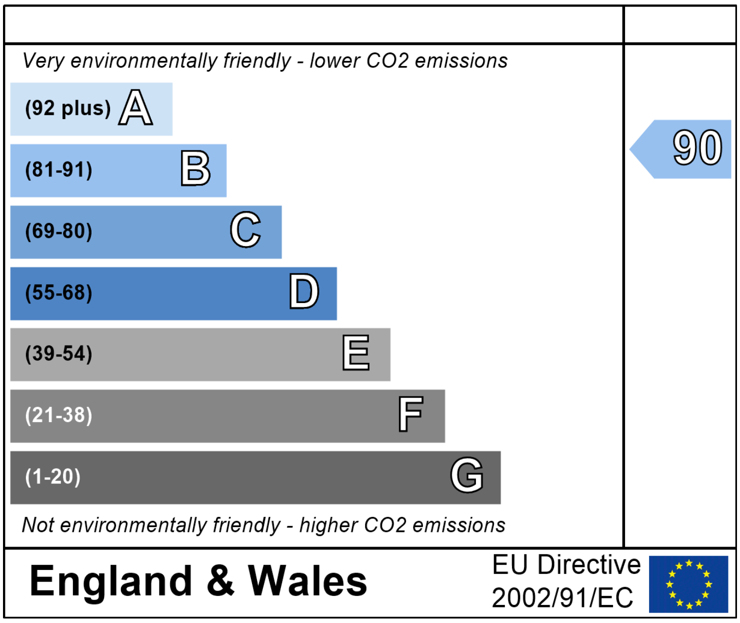
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)$_{1…12}$ /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.6	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.69	19.83	20.09	20.43	20.73	20.93	20.98	20.97	20.82	20.42	19.99	19.67	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.68	0.47	0.54	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	18.9	19.16	19.5	19.78	19.94	19.97	19.97	19.87	19.5	19.07	18.74	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.36	19.61	19.95	20.25	20.42	20.47	20.46	20.34	19.95	19.52	19.2	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.72	0.54	0.6	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.03	404.08	457.94	505.51	499.84	400.77	283.59	293.29	379.58	374.21	343.07	336.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1142.27	1104.9	1000.19	836.12	645.63	436.49	289.86	303.96	468.95	706.11	941.32	1140.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	585.71	470.95	403.43	238.04	108.47	0	0	0	0	246.93	430.74	597.77	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3082.04 (98)

Space heating requirement in kWh/m²/year 46.43 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	704.8	554.84	569.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	598.92	507.82	505.36	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	93.61	140.94	110.04	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 344.59 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	23.4	35.23	27.51	0	0	0	0

Total = $Sum(107)_{6...8}$ = 86.15 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.3 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 47.73 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1\ldots12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	118.39	103.55	106.85	93.16	89.38	77.13	71.47	82.02	83	96.73	105.58	114.66

Output from water heater (annual)$_{1...12}$ 1141.92 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	29.6	25.89	26.71	23.29	22.35	19.28	17.87	20.5	20.75	24.18	26.4	28.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	39.78	38.52	35.9	32.35	30.04	26.78	24.02	27.56	28.82	32.5	36.66	38.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	302.01	300.68	290.1	272.85	254.76	237.89	227.3	230.92	240.13	257.52	277.45	292.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	355.73	405.76	463.17	525.26	564.1	554.55	528.78	489.88	441.42	382.21	344.43	337.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.64	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.89	20.14	20.47	20.77	20.94	20.99	20.98	20.85	20.46	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.46	0.52	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.86	18.99	19.24	19.58	19.85	19.99	20.01	20.01	19.92	19.57	19.15	18.84	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.3	19.43	19.68	20.01	20.29	20.45	20.49	20.48	20.37	20	19.59	19.27	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.88	0.71	0.52	0.58	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.05	404.09	457.81	504.41	495.41	391.95	274.86	284.98	375.42	373.88	343.08	336.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1101.95	1065.89	964.95	806.54	622.69	420.67	279.51	293.12	452.45	681.32	907.94	1099.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	555.7	444.73	377.32	217.53	94.7	0	0	0	0	228.73	406.7	567.58	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2892.98	(98)
Space heating requirement in kWh/m²/year	43.58	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	675.8	532.01	545.61	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	588.38	494.95	494.32	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	728.93	697.25	653.27	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	101.19	150.51	118.26	0	0	0	0	

	Total = $Sum(104)_{6...8}$ =	369.96	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	25.3	37.63	29.56	0	0	0	0

	Total = $Sum(107)_{6...8}$ =	92.49	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.39	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	44.98	(109)
Target Fabric Energy Efficiency (TFEE)		51.72	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	66.38	(1a)	x	2.3	(2a)	=	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 17.66 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.81 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.57	76.43	76.29	75.65	75.53	74.98	74.98	74.88	75.19	75.53	75.78	76.03	

Average = Sum(39)$_{1…12}$ /12= 75.65 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.15

Average = Sum(40)1…12 /12= 1.14 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92	
											Total = Sum(44)1…12 =	1024.61	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89	
											Total = Sum(45)1…12 =	1343.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.61	13.17	14.55	14.03	14.47	13.97	14.41	14.45	14	14.51	14.1	14.6	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49	

Output from water heater (annual)$_{1...12}$ 1514.3 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	49.96	43.8	45.43	39.95	38.58	33.66	31.56	35.7	35.97	41.47	44.83	48.5	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	129.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.49	40.41	32.86	24.88	18.6	15.7	16.96	22.05	29.6	37.58	43.86	46.76	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	281.65	284.57	277.21	261.53	241.74	223.13	210.71	207.78	215.15	230.83	250.62	269.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	50.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)
Water heating gains (Table 5)													
(72)m=	67.16	65.18	61.07	55.48	51.86	46.76	42.42	47.98	49.95	55.73	62.26	65.19	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	490.49	486.34	467.32	438.08	408.38	381.78	366.28	374	390.89	420.33	452.93	477.36	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	544.21	591.43	640.39	690.49	717.72	698.44	667.76	632.96	592.17	545.03	519.91	521.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.49	0.53	0.78	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.08	20.32	20.61	20.84	20.96	20.99	20.99	20.92	20.62	20.23	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.96	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.9	0.77	0.56	0.38	0.42	0.69	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.78	19.11	19.53	19.82	19.95	19.97	19.97	19.91	19.54	19	18.55	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.26	19.42	19.7	20.06	20.32	20.45	20.47	20.47	20.4	20.07	19.6	19.22	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.27	19.55	19.91	20.17	20.3	20.32	20.32	20.25	19.92	19.45	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.9	0.78	0.59	0.42	0.46	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	536.98	578.92	613.67	623.14	562.62	412.98	277.16	290.37	425.51	502.34	507.74	515.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.7	1098	995.52	832.63	639.95	427.22	279.07	293.51	462.56	703.88	936.05	1130.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	443.96	348.82	284.1	150.84	57.53	0	0	0	0	149.94	308.39	457.47	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2201.05	(98)
Space heating requirement in kWh/m²/year	33.16	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	443.96	348.82	284.1	150.84	57.53	0	0	0	0	149.94	308.39	457.47		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	490.56	385.44	313.92	166.67	63.57	0	0	0	0	165.68	340.76	505.49		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2432.09	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	153.89	134.99	140.25	123.63	119.63	104.71	98.5	110.94	111.65	128.31	138.31	149.49		
Efficiency of water heater													87.3	(216)
(217)m=	89.65	89.58	89.42	89.03	88.31	87.3	87.3	87.3	87.3	89	89.48	89.69		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	171.65	150.69	156.85	138.86	135.46	119.94	112.83	127.08	127.89	144.17	154.56	166.67		
Total = Sum(219a)$_{1...12}$ =													1706.66	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2432.09	
Water heating fuel used			1706.66	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)
Electricity generated by PVs			-516.37	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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Space heating - main system 1	(211) x	3.48	x 0.01 =	84.64 (240)
Space heating - main system 2	(213) x	0	x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	59.39 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89 (249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.39 (250)
Additional standing charges (Table 12)				120 (251)
	one of (233) to (235) x)	13.19	x 0.01 =	0 (252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	316.31 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.19 (257)
SAP rating (Section 12)		83.36 (258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	525.33 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	368.64 (264)
Space and water heating	(261) + (262) + (263) + (264) =			893.97 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	166.79 (268)
Energy saving/generation technologies Item 1		0.519	=	-268 (269)
Total CO2, kg/year		sum of (265)…(271) =		831.69 (272)
CO2 emissions per m²		(272) ÷ (4) =		12.53 (273)
EI rating (section 14)				90 (274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year
Space heating (main system 1)	(211) x	1.22	=	2967.16 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	1.22	=	2082.13 (264)
Space and water heating	(261) + (262) + (263) + (264) =			5049.28 (265)

Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	986.62	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1585.27	(269)
‘Total Primary Energy	sum of (265)…(271) =			4680.88	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			70.52	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 4 - PV

Address : Flat 4, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.38	(1a) x	2.3	(2a) =	152.67	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.38	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	152.67	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			8.95	x1/[1/(1.4)+ 0.04]		=	11.87			(27)
Floor			66.38	x	0.13	=	8.629399			(28)
Walls	40.67	11.15	29.52	x	0.18	=	5.31			(29)
Roof	2.88	0	2.88	x	0.13	=	0.37			(30)
Total area of elements, m²			109.93							(31)
Party wall			36.49	x	0	=	0			(32)
Party ceiling			63.5							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6036.77 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.34 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.72 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.76	28.62	28.49	27.85	27.73	27.17	27.17	27.07	27.39	27.73	27.97	28.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.48	73.34	73.21	72.57	72.45	71.89	71.89	71.79	72.11	72.45	72.69	72.94	

Average = Sum(39)$_{1…12}$ /12= 72.57 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.16 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 85.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	93.92	90.51	87.09	83.68	80.26	76.85	76.85	80.26	83.68	87.09	90.51	93.92

Total = Sum(44)$_{1…12}$ = 1024.61 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	139.29	121.82	125.71	109.59	105.16	90.74	84.09	96.49	97.64	113.79	124.22	134.89

Total = Sum(45)$_{1…12}$ = 1343.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.89	18.27	18.86	16.44	15.77	13.61	12.61	14.47	14.65	17.07	18.63	20.23	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	47.86	41.66	44.38	41.27	40.9	37.9	39.16	40.9	41.27	44.38	44.63	47.86	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75	

Output from water heater (annual) $_{1...12}$ 1855.6 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	58.28	50.92	52.89	46.76	45.19	39.65	37.75	42.31	42.78	48.93	52.46	56.82	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	107.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.2	16.16	13.14	9.95	7.44	6.28	6.79	8.82	11.84	15.03	17.54	18.7	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	188.71	190.66	185.73	175.22	161.96	149.5	141.17	139.22	144.15	154.66	167.92	180.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	33.78	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	-86.21	(71)

Water heating gains (Table 5)

(72)m=	78.33	75.77	71.09	64.94	60.74	55.06	50.74	56.87	59.42	65.77	72.86	76.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	343.56	340.93	328.29	308.44	288.47	269.17	257.02	263.23	273.74	293.78	316.65	333.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	8.95	x	19.64	x	0.63	x	0.7	=	53.72	(76)
East	0.9x	0.77	x	8.95	x	38.42	x	0.63	x	0.7	=	105.09	(76)
East	0.9x	0.77	x	8.95	x	63.27	x	0.63	x	0.7	=	173.07	(76)
East	0.9x	0.77	x	8.95	x	92.28	x	0.63	x	0.7	=	252.41	(76)
East	0.9x	0.77	x	8.95	x	113.09	x	0.63	x	0.7	=	309.34	(76)

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East	0.9x	0.77	x	8.95	x	115.77	x	0.63	x	0.7	=	316.66	(76)
East	0.9x	0.77	x	8.95	x	110.22	x	0.63	x	0.7	=	301.47	(76)
East	0.9x	0.77	x	8.95	x	94.68	x	0.63	x	0.7	=	258.96	(76)
East	0.9x	0.77	x	8.95	x	73.59	x	0.63	x	0.7	=	201.28	(76)
East	0.9x	0.77	x	8.95	x	45.59	x	0.63	x	0.7	=	124.7	(76)
East	0.9x	0.77	x	8.95	x	24.49	x	0.63	x	0.7	=	66.98	(76)
East	0.9x	0.77	x	8.95	x	16.15	x	0.63	x	0.7	=	44.18	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	53.72	105.09	173.07	252.41	309.34	316.66	301.47	258.96	201.28	124.7	66.98	44.18	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	397.28	446.02	501.36	560.85	597.8	585.83	558.5	522.19	475.02	418.48	383.63	377.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.89	0.72	0.55	0.61	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.95	20.19	20.52	20.79	20.95	20.99	20.98	20.87	20.51	20.1	19.79	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.64	0.44	0.49	0.79	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.41	18.61	18.97	19.43	19.8	19.98	20.01	20.01	19.91	19.43	18.84	18.38	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.26	19.56	19.96	20.29	20.45	20.49	20.48	20.38	19.96	19.46	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.26	19.56	19.96	20.29	20.45	20.49	20.48	20.38	19.96	19.46	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.49	0.55	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	395.91	443.03	492.9	531.9	511.73	397.15	275.91	286.98	389.23	405.04	381.05	376.94	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1087.4	1053.5	956.44	802.79	622.06	420.82	279.59	293.25	452.69	677.84	898.18	1084.51	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	514.47	410.24	344.87	195.04	82.09	0	0	0	0	202.97	372.34	526.43	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2648.44	(98)
Space heating requirement in kWh/m²/year	39.9	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	514.47	410.24	344.87	195.04	82.09	0	0	0	0	202.97	372.34	526.43		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	550.82	439.22	369.24	208.82	87.89	0	0	0	0	217.31	398.65	563.63		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2835.59	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	187.15	163.48	170.09	150.86	146.06	128.64	123.25	137.39	138.91	158.18	168.85	182.75		
Efficiency of water heater													80.3	(216)
(217)m=	87.47	87.27	86.79	85.7	83.66	80.3	80.3	80.3	80.3	85.68	86.99	87.56		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	213.97	187.32	195.97	176.03	174.58	160.2	153.48	171.1	172.99	184.61	194.11	208.71		
Total = Sum(219a)$_{1...12}$ =													2193.07	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2835.59	
Water heating fuel used			2193.07	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.37	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	612.49	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	473.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1086.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1291.91	(272)

TER = 19.46 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:54

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 49.49m²

Site Reference : Lawnwood House **Plot Reference:** Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	43.83 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	30.30 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	96.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	88.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	2.24m²
Windows facing: West	5.75m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1...12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
											Total = Sum(44)$_{1...12}$ =	887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
											Total = Sum(45)$_{1...12}$ =	1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	

Output from water heater (annual)$_{1...12}$ 1891.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	89.54	79.73	85.63	79.39	79.71	73.96	73.64	77.21	75.95	82.2	83.6	88.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	120.35	118.64	115.09	110.27	107.13	102.72	98.97	103.78	105.48	110.48	116.12	118.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	330.93	329.22	319.61	304.29	289.03	274.12	264.31	269.11	276.88	292.38	310.14	323.17	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25 (76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45 (76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81 (76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38 (76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21 (76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76 (76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06 (76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51 (80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52 (80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19 (80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16 (80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73 (80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44 (80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68 (80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37 (80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32 (80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11 (80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03 (80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38 (80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	378.89	423.04	474.11	529.62	565.19	556.81	533.45	500.3	456.58	403.7	369.94	362.61 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.99	0.98	0.96	0.91	0.8	0.66	0.71	0.89	0.97	0.99	1 (86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.99	19.16	19.49	19.96	20.4	20.75	20.91	20.88	20.6	20.03	19.43	18.96 (87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4 (88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.86	0.68	0.47	0.52	0.81	0.95	0.99	0.99 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.82	17.06	17.55	18.22	18.83	19.26	19.39	19.38	19.1	18.34	17.47	16.78 (90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.08	18.28	18.68	19.23	19.75	20.13	20.27	20.25	19.98	19.32	18.61	18.05 (92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	18.08	18.28	18.68	19.23	19.75	20.13	20.27	20.25	19.98	19.32	18.61	18.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.87	0.74	0.58	0.63	0.84	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.96	416.37	460.47	497.34	492.36	413.75	310.62	316.15	383.52	384.84	363.8	359.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1306.78	1266.6	1150.55	967	752	512.45	340.6	356.65	546.49	815.06	1079.74	1303.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	693.28	571.36	513.42	338.16	193.17	0	0	0	0	320.08	515.48	702.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3847.43 (98)

Space heating requirement in kWh/m²/year 77.74 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	693.28	571.36	513.42	338.16	193.17	0	0	0	0	320.08	515.48	702.48	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	277.42	228.63	205.45	135.32	77.3	0	0	0	0	128.08	206.27	281.11	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1539.59 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	104.2	92.14	97.48	88.37	87.31	79.04	76.88	83.02	82.45	91.58	95.6	102.02	

Total = Sum(219a)$_{1...12}$ = 1080.11 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1539.59

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Water heating fuel used			1080.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	799.05	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	560.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1359.62	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	124.17	(268)
Total CO2, kg/year			sum of (265)…(271) =		1499.36	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		30.3	(273)
EI rating (section 14)					79	(274)

Predicted Energy Assessment

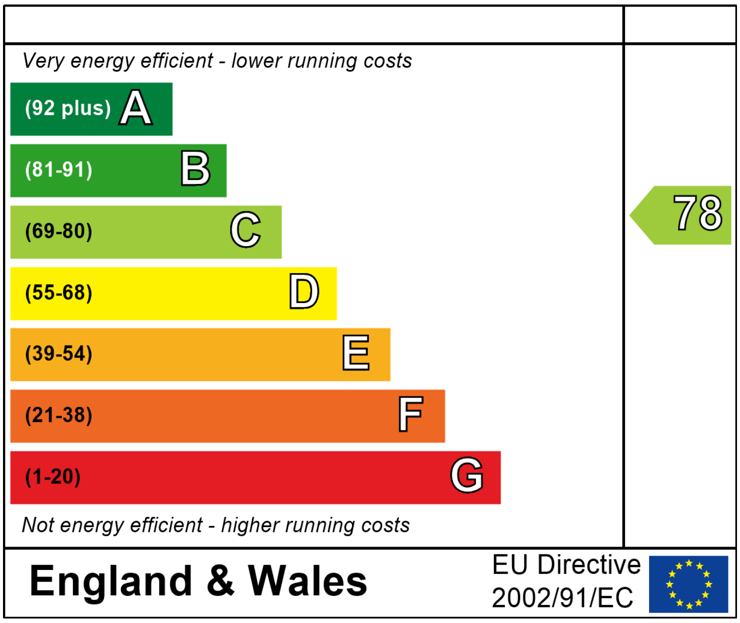
Flat 5
Lawnwood House, Lawnwood Road, Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	49.49 m²

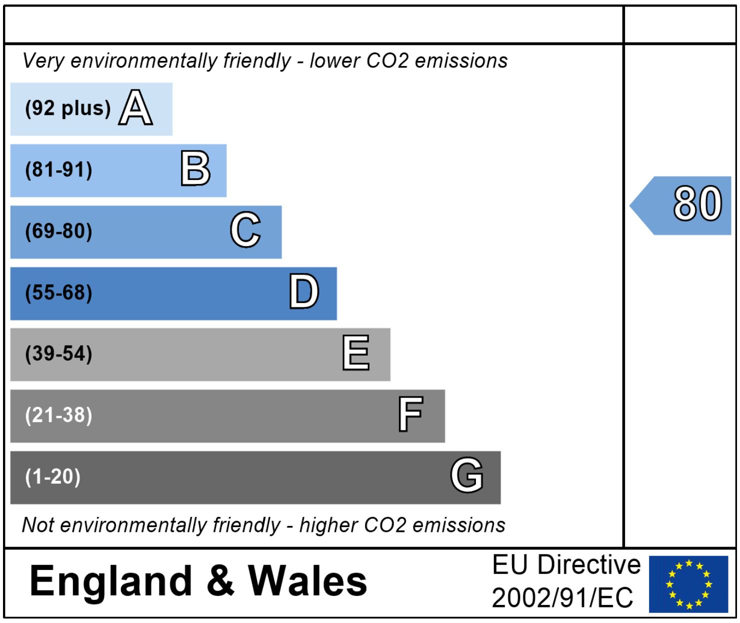
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1…12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1…12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25 (76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45 (76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81 (76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38 (76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21 (76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76 (76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06 (76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51 (80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52 (80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19 (80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16 (80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73 (80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44 (80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68 (80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37 (80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32 (80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11 (80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03 (80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38 (80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.85	0.73	0.78	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.84	19.02	19.36	19.83	20.3	20.68	20.87	20.83	20.51	19.9	19.29	18.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.75	0.54	0.6	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.49	17.66	18	18.48	18.93	19.27	19.39	19.37	19.13	18.55	17.95	17.47	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.8	0.65	0.71	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.75	332.27	381.09	427.54	437.85	380.89	295.68	295.84	333.79	310.74	280.58	273.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1325.43	1282.38	1160.85	970.33	750.15	509.2	338.6	354.01	542.28	816.39	1090.54	1322.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	771.29	638.47	580.14	390.8	232.35	0	0	0	0	376.21	583.17	780.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4353.09 (98)

Space heating requirement in kWh/m²/year 87.96 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	871.62	686.17	703.68	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.63	0.72	0.67	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	548.61	490.85	474.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	50.01	74.64	57.28	0	0	0	0

Total = Sum(104)$_{6...8}$ = 181.93 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	12.5	18.66	14.32	0	0	0	0

Total = Sum(107)$_{6...8}$ = 45.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.92 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 88.88 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = Sum(40)$_{1\ldots12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1\ldots12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1\ldots12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1…12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

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East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.84	0.72	0.77	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.94	19.11	19.44	19.91	20.36	20.72	20.89	20.86	20.55	19.96	19.37	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.74	0.53	0.59	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.63	17.8	18.13	18.6	19.03	19.35	19.46	19.45	19.22	18.66	18.07	17.61	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.79	0.64	0.7	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.81	332.35	381.15	427.29	436.34	376.79	289.69	290.92	332.38	310.73	280.65	273.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1272.17	1230.87	1114.41	931.52	720.47	489.12	325.53	340.39	521.22	783.97	1046.57	1269.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	731.62	603.81	545.54	363.05	211.4	0	0	0	0	352.09	551.46	740.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	4099.69	(98)
Space heating requirement in kWh/m²/year	82.84	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	828.8	652.46	669.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.66	0.74	0.7	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	544.24	484.39	469.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.16	79.44	60.98	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	193.57	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	13.29	19.86	15.24	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	48.39	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.98	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	83.82	(109)
Target Fabric Energy Efficiency (TFEE)		96.39	(109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.49	(1a) x	2.3	(2a) =	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9	
											Average = Sum(40)$_{1…12}$ /12=	1.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9) if TFA £ 13.9, N = 1	1.68	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.98	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38		
										Total = Sum(44)$_{1…12}$ =			887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88		
										Total = Sum(45)$_{1…12}$ =			1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		210	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)			
Water storage loss:			
a) If manufacturer’s declared loss factor is known (kWh/day):		2.3	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.24	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		1.24	(55)
Water storage loss calculated for each month	((56)m = (55) × (41)m		

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	

Output from water heater (annual)$_{1...12}$ 1891.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	89.54	79.73	85.63	79.39	79.71	73.96	73.64	77.21	75.95	82.2	83.6	88.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	33.87	30.08	24.46	18.52	13.84	11.69	12.63	16.42	22.03	27.98	32.65	34.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	217.78	220.04	214.34	202.22	186.91	172.53	162.92	160.66	166.36	178.48	193.78	208.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)
Water heating gains (Table 5)													
(72)m=	120.35	118.64	115.09	110.27	107.13	102.72	98.97	103.78	105.48	110.48	116.12	118.65	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	455.22	451.98	437.12	414.23	391.12	370.17	357.75	364.08	377.1	400.16	425.78	444.85	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	503.18	545.8	591.63	639.57	667.27	652.86	626.89	595.27	556.8	511.48	485.58	484.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.87	0.74	0.59	0.63	0.83	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.19	19.35	19.67	20.1	20.51	20.81	20.94	20.92	20.7	20.18	19.62	19.16	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.91	0.8	0.61	0.41	0.45	0.73	0.92	0.97	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.1	17.34	17.8	18.42	18.96	19.31	19.4	19.39	19.2	18.54	17.73	17.07	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.32	18.51	18.89	19.4	19.86	20.18	20.29	20.28	20.07	19.5	18.83	18.28	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.32	18.51	18.89	19.4	19.86	20.18	20.29	20.28	20.07	19.5	18.83	18.28	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.91	0.82	0.68	0.51	0.56	0.77	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	491.7	528.75	561.89	579.97	549.93	443.4	322.07	331.73	431.4	469.89	468.89	474.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1329.19	1288.24	1170.18	982.91	762.78	517.56	342.5	359.23	555.14	831.37	1099.85	1325.51	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	623.09	510.38	452.57	290.12	158.36	0	0	0	0	268.94	454.29	633.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3390.91 (98)

Space heating requirement in kWh/m²/year 68.52 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	623.09	510.38	452.57	290.12	158.36	0	0	0	0	268.94	454.29	633.16	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	249.34	204.23	181.1	116.1	63.37	0	0	0	0	107.62	181.79	253.36	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1356.91 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	104.2	92.14	97.48	88.37	87.31	79.04	76.88	83.02	82.45	91.58	95.6	102.02	

Total = Sum(219a)$_{1...12}$ = 1080.11 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1356.91

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Water heating fuel used			1080.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			239.24	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	178.98	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	142.47	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	31.56	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	356.96	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.59	(257)
SAP rating (Section 12)		77.87	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	704.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	560.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1264.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1404.55	(272)
CO2 emissions per m²		(272) ÷ (4) =		28.38	(273)
EI rating (section 14)				80	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	4165.7	(261)

Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3315.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7481.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	734.48	(268)
‘Total Primary Energy	sum of (265)…(271) =			8308.22	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			167.88	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.49	(1a) x	2.3	(2a) =	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = Sum(40)$_{1…12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
										Total = Sum(44)$_{1…12}$ =		887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
										Total = Sum(45)$_{1…12}$ =		1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	

Output from water heater (annual)$_{1...12}$ 1773.32 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	81.53	72.49	77.61	71.64	71.69	66.21	65.62	69.2	68.19	74.18	75.85	80.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	109.58	107.87	104.32	99.49	96.36	91.95	88.2	93.01	94.71	99.71	105.35	107.88	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	320.16	318.45	308.84	293.51	278.26	263.35	253.54	258.34	266.11	281.61	299.37	312.4	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	368.12	412.27	463.34	518.85	554.41	546.04	522.67	489.53	445.81	392.93	359.17	351.84	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.91	0.8	0.65	0.7	0.89	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.07	19.24	19.56	20.02	20.45	20.78	20.92	20.9	20.63	20.08	19.5	19.04	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.86	0.68	0.47	0.52	0.81	0.96	0.99	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.97	17.22	17.69	18.35	18.94	19.34	19.46	19.45	19.19	18.45	17.61	16.94	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.39	18.78	19.32	19.82	20.18	20.31	20.29	20.03	19.4	18.71	18.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.19	18.39	18.78	19.32	19.82	20.18	20.31	20.29	20.03	19.4	18.71	18.16	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.94	0.87	0.74	0.58	0.63	0.84	0.96	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.7	406.32	450.76	488.01	483	403.91	301.41	307.22	374.83	375.51	353.76	349.05	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1254.12	1215.54	1104.21	927.84	721.6	491.58	327.02	342.4	524.46	781.96	1035.76	1250.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	661.72	543.8	486.17	316.68	177.51	0	0	0	0	302.4	491.04	670.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3650.05 (98)

Space heating requirement in kWh/m²/year 73.75 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	661.72	543.8	486.17	316.68	177.51	0	0	0	0	302.4	491.04	670.72	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	707.73	581.6	519.97	338.69	189.85	0	0	0	0	323.42	525.18	717.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3903.79 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	
Efficiency of water heater												79.8	(216)
(217)m=	88.06	87.92	87.58	86.84	85.39	79.8	79.8	79.8	79.8	86.64	87.64	88.13	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	195.82	173.22	183.45	167.01	167.3	161.28	156.15	169.62	168.78	173.53	179.94	191.35	

Total = Sum(219a)$_{1...12}$ = 2087.43 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3903.79

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Water heating fuel used			2087.43	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	843.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	450.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1294.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1457.2	(272)

TER = 43.83 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:44

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 49.49m²

Site Reference : Lawnwood House **Plot Reference:** Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity		
Fuel factor: 1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	43.83 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	24.79 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	96.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	88.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

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6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	2.24m²
Windows facing: West	5.75m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = $Sum(39)_{1…12}$ /12= 93.62 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
 if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
										Total = Sum(44)$_{1…12}$ =		887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
										Total = Sum(45)$_{1…12}$ =		1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

 Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	

Output from water heater (annual)$_{1...12}$ 1891.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	89.54	79.73	85.63	79.39	79.71	73.96	73.64	77.21	75.95	82.2	83.6	88.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	120.35	118.64	115.09	110.27	107.13	102.72	98.97	103.78	105.48	110.48	116.12	118.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	330.93	329.22	319.61	304.29	289.03	274.12	264.31	269.11	276.88	292.38	310.14	323.17	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	378.89	423.04	474.11	529.62	565.19	556.81	533.45	500.3	456.58	403.7	369.94	362.61	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.91	0.8	0.66	0.71	0.89	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.99	19.16	19.49	19.96	20.4	20.75	20.91	20.88	20.6	20.03	19.43	18.96	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.86	0.68	0.47	0.52	0.81	0.95	0.99	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.82	17.06	17.55	18.22	18.83	19.26	19.39	19.38	19.1	18.34	17.47	16.78	(90)

fLA = Living area ÷ (4) = | 0.58 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.08	18.28	18.68	19.23	19.75	20.13	20.27	20.25	19.98	19.32	18.61	18.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.08	18.28	18.68	19.23	19.75	20.13	20.27	20.25	19.98	19.32	18.61	18.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.87	0.74	0.58	0.63	0.84	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.96	416.37	460.47	497.34	492.36	413.75	310.62	316.15	383.52	384.84	363.8	359.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1306.78	1266.6	1150.55	967	752	512.45	340.6	356.65	546.49	815.06	1079.74	1303.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	693.28	571.36	513.42	338.16	193.17	0	0	0	0	320.08	515.48	702.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3847.43 (98)

Space heating requirement in kWh/m²/year 77.74 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	693.28	571.36	513.42	338.16	193.17	0	0	0	0	320.08	515.48	702.48	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	277.42	228.63	205.45	135.32	77.3	0	0	0	0	128.08	206.27	281.11	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1539.59 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	
Efficiency of water heater													175.1 (216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	104.2	92.14	97.48	88.37	87.31	79.04	76.88	83.02	82.45	91.58	95.6	102.02	

Total = Sum(219a)$_{1...12}$ = 1080.11 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1539.59

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Water heating fuel used			1080.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			239.24	(232)
Electricity generated by PVs			-524.74	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	799.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	560.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1359.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Energy saving/generation technologies Item 1		0.519	=	-272.34	(269)
Total CO2, kg/year		sum of (265)…(271) =		1227.02	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		24.79	(273)
EI rating (section 14)				83	(274)

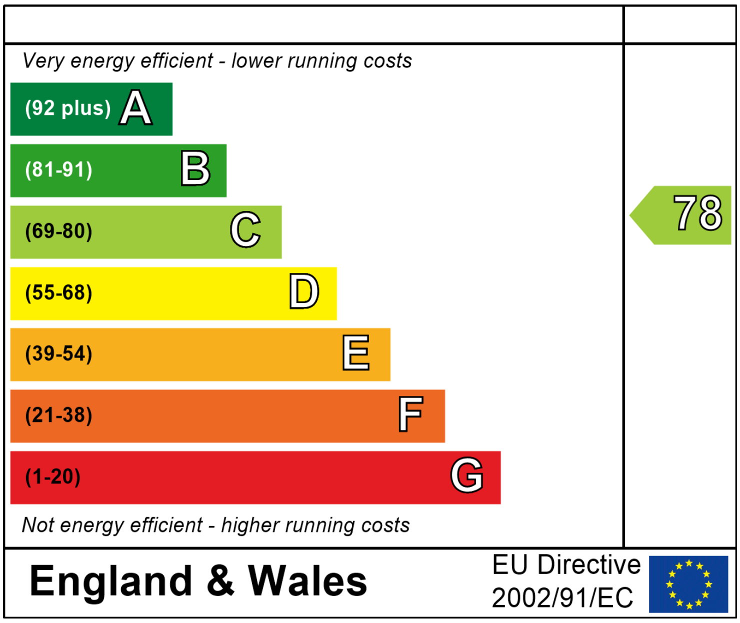
Predicted Energy Assessment

Flat 5	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road, Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	49.49 m²
BS5 0EF		

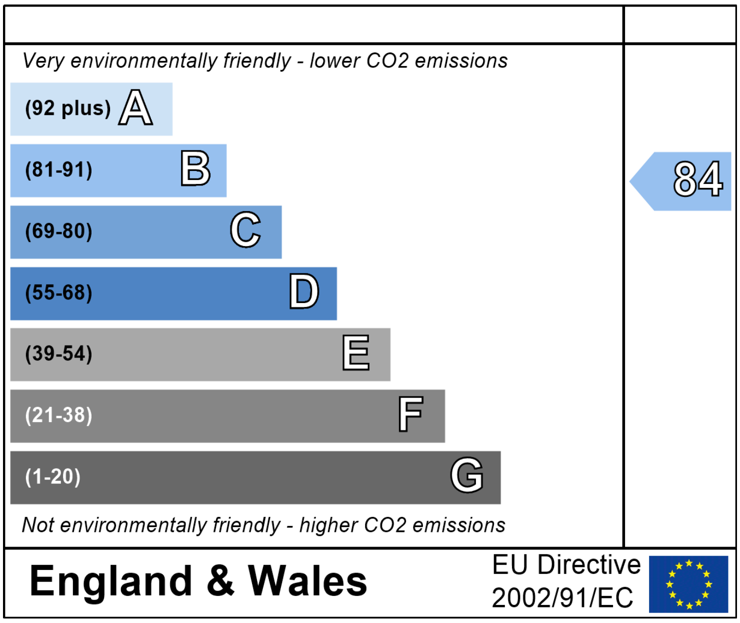
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1\ldots12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
Total = Sum(44)$_{1\ldots12}$ =												887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
Total = Sum(45)$_{1\ldots12}$ =												1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.85	0.73	0.78	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.84	19.02	19.36	19.83	20.3	20.68	20.87	20.83	20.51	19.9	19.29	18.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.75	0.54	0.6	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.49	17.66	18	18.48	18.93	19.27	19.39	19.37	19.13	18.55	17.95	17.47	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.8	0.65	0.71	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.75	332.27	381.09	427.54	437.85	380.89	295.68	295.84	333.79	310.74	280.58	273.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1325.43	1282.38	1160.85	970.33	750.15	509.2	338.6	354.01	542.28	816.39	1090.54	1322.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	771.29	638.47	580.14	390.8	232.35	0	0	0	0	376.21	583.17	780.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4353.09 (98)

Space heating requirement in kWh/m²/year 87.96 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	871.62	686.17	703.68	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.63	0.72	0.67	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	548.61	490.85	474.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	50.01	74.64	57.28	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 181.93 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	12.5	18.66	14.32	0	0	0	0

Total = Sum(107)$_{6...8}$ = 45.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.92 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 88.88 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.49	(1a) x	2.3	(2a) =	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = $Sum(40)_{1...12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = $Sum(44)_{1...12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = $Sum(45)_{1...12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ | 989.44 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

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East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.84	0.72	0.77	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.94	19.11	19.44	19.91	20.36	20.72	20.89	20.86	20.55	19.96	19.37	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.74	0.53	0.59	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.63	17.8	18.13	18.6	19.03	19.35	19.46	19.45	19.22	18.66	18.07	17.61	(90)

fLA = Living area ÷ (4) = | 0.58 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.79	0.64	0.7	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.81	332.35	381.15	427.29	436.34	376.79	289.69	290.92	332.38	310.73	280.65	273.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1272.17	1230.87	1114.41	931.52	720.47	489.12	325.53	340.39	521.22	783.97	1046.57	1269.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	731.62	603.81	545.54	363.05	211.4	0	0	0	0	352.09	551.46	740.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	4099.69	(98)
Space heating requirement in kWh/m²/year	82.84	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	828.8	652.46	669.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.66	0.74	0.7	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	544.24	484.39	469.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	53.16	79.44	60.98	0	0	0	0

	Total = Sum(104)$_{6...8}$ =	193.57	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	13.29	19.86	15.24	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	48.39	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.98	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	83.82	(109)
Target Fabric Energy Efficiency (TFEE)		96.39	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9		
											Average = Sum(40)$_{1…12}$ /12=		1.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38		
										Total = Sum(44)$_{1…12}$ =			887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88		
										Total = Sum(45)$_{1…12}$ =			1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64	

Output from water heater (annual)$_{1...12}$ 1891.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	89.54	79.73	85.63	79.39	79.71	73.96	73.64	77.21	75.95	82.2	83.6	88.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	33.87	30.08	24.46	18.52	13.84	11.69	12.63	16.42	22.03	27.98	32.65	34.81	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	217.78	220.04	214.34	202.22	186.91	172.53	162.92	160.66	166.36	178.48	193.78	208.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	120.35	118.64	115.09	110.27	107.13	102.72	98.97	103.78	105.48	110.48	116.12	118.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	455.22	451.98	437.12	414.23	391.12	370.17	357.75	364.08	377.1	400.16	425.78	444.85	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	503.18	545.8	591.63	639.57	667.27	652.86	626.89	595.27	556.8	511.48	485.58	484.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.87	0.74	0.59	0.63	0.83	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.19	19.35	19.67	20.1	20.51	20.81	20.94	20.92	20.7	20.18	19.62	19.16	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.91	0.8	0.61	0.41	0.45	0.73	0.92	0.97	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.1	17.34	17.8	18.42	18.96	19.31	19.4	19.39	19.2	18.54	17.73	17.07	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.32	18.51	18.89	19.4	19.86	20.18	20.29	20.28	20.07	19.5	18.83	18.28	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	18.32	18.51	18.89	19.4	19.86	20.18	20.29	20.28	20.07	19.5	18.83	18.28	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.98	0.97	0.95	0.91	0.82	0.68	0.51	0.56	0.77	0.92	0.97	0.98		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	491.7	528.75	561.89	579.97	549.93	443.4	322.07	331.73	431.4	469.89	468.89	474.5		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1329.19	1288.24	1170.18	982.91	762.78	517.56	342.5	359.23	555.14	831.37	1099.85	1325.51		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	623.09	510.38	452.57	290.12	158.36	0	0	0	0	268.94	454.29	633.16		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													3390.91	(98)
Space heating requirement in kWh/m²/year													68.52	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	623.09	510.38	452.57	290.12	158.36	0	0	0	0	268.94	454.29	633.16		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	249.34	204.23	181.1	116.1	63.37	0	0	0	0	107.62	181.79	253.36		
Total (kWh/year) =Sum(211)1...5,10...12=													1356.91	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

Output from water heater (calculated above)														
	182.45	161.34	170.69	154.73	152.88	138.4	134.62	145.37	144.38	160.36	167.4	178.64		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	104.2	92.14	97.48	88.37	87.31	79.04	76.88	83.02	82.45	91.58	95.6	102.02		
Total = Sum(219a)1...12 =													1080.11	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1356.91

Water heating fuel used			1080.11	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			239.24	(232)
Electricity generated by PVs			-524.74	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	178.98	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	142.47	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	31.56	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			356.96	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.59	(257)
SAP rating (Section 12)		77.87	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	704.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	560.58	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1264.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-272.34	(269)
Total CO2, kg/year	sum of (265)…(271) =			1132.21	(272)

CO2 emissions per m²	(272) ÷ (4) =	22.88	(273)
EI rating (section 14)		84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	4165.7	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3315.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7481.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	734.48	(268)
Energy saving/generation technologies Item 1		3.07	=	-1610.95	(269)
'Total Primary Energy		sum of (265)…(271) =		6697.27	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		135.33	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - ASHP + PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.49	(1a) x	2.3	(2a) =	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = Sum(40)$_{1...12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
									Total = Sum(44)$_{1...12}$ =			887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
									Total = Sum(45)$_{1...12}$ =			1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	

Output from water heater (annual)$_{1...12}$ 1773.32 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	81.53	72.49	77.61	71.64	71.69	66.21	65.62	69.2	68.19	74.18	75.85	80.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)
Water heating gains (Table 5)													
(72)m=	109.58	107.87	104.32	99.49	96.36	91.95	88.2	93.01	94.71	99.71	105.35	107.88	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	320.16	318.45	308.84	293.51	278.26	263.35	253.54	258.34	266.11	281.61	299.37	312.4	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

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East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	368.12	412.27	463.34	518.85	554.41	546.04	522.67	489.53	445.81	392.93	359.17	351.84	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.91	0.8	0.65	0.7	0.89	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.07	19.24	19.56	20.02	20.45	20.78	20.92	20.9	20.63	20.08	19.5	19.04	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.86	0.68	0.47	0.52	0.81	0.96	0.99	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.97	17.22	17.69	18.35	18.94	19.34	19.46	19.45	19.19	18.45	17.61	16.94	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.39	18.78	19.32	19.82	20.18	20.31	20.29	20.03	19.4	18.71	18.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.19	18.39	18.78	19.32	19.82	20.18	20.31	20.29	20.03	19.4	18.71	18.16	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.94	0.87	0.74	0.58	0.63	0.84	0.96	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.7	406.32	450.76	488.01	483	403.91	301.41	307.22	374.83	375.51	353.76	349.05	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1254.12	1215.54	1104.21	927.84	721.6	491.58	327.02	342.4	524.46	781.96	1035.76	1250.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	661.72	543.8	486.17	316.68	177.51	0	0	0	0	302.4	491.04	670.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3650.05 (98)

Space heating requirement in kWh/m²/year 73.75 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	661.72	543.8	486.17	316.68	177.51	0	0	0	0	302.4	491.04	670.72	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	707.73	581.6	519.97	338.69	189.85	0	0	0	0	323.42	525.18	717.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3903.79 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	172.43	152.29	160.67	145.04	142.86	128.7	124.61	135.35	134.68	150.35	157.71	168.63	
Efficiency of water heater												79.8	(216)
(217)m=	88.06	87.92	87.58	86.84	85.39	79.8	79.8	79.8	79.8	86.64	87.64	88.13	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	195.82	173.22	183.45	167.01	167.3	161.28	156.15	169.62	168.78	173.53	179.94	191.35	

Total = Sum(219a)$_{1...12}$ = 2087.43 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3903.79

TER WorkSheet: New dwelling design stage

Water heating fuel used			2087.43	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	843.22	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	450.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1294.1	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	124.17	(268)
Total CO2, kg/year			sum of (265)…(271) =		1457.2	(272)

TER = 43.83 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:34:04

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 49.49m²

Site Reference : Lawnwood House **Plot Reference:** Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	29.4 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	29.24 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	96.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	88.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	2.24m²
Windows facing: West	5.75m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	49.49	(1a) x	2.3	(2a) =	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1…12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1…12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.51	13.09	14.46	13.96	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.5	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	

Output from water heater (annual)$_{1...12}$ | 1334.05 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.76	38.37	39.83	35.07	33.9	29.62	27.82	31.4	31.62	36.39	39.29	42.49	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	58.81	57.1	53.54	48.7	45.56	41.14	37.39	42.2	43.91	48.92	54.57	57.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.4	267.68	258.06	242.72	227.46	212.54	202.72	207.54	215.31	230.82	248.59	261.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	317.35	361.5	412.56	468.06	503.61	495.23	471.86	438.72	395	342.14	308.39	301.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.93	0.84	0.72	0.76	0.92	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.89	19.06	19.4	19.87	20.33	20.7	20.88	20.85	20.53	19.94	19.33	18.86	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.96	0.89	0.73	0.52	0.58	0.85	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.67	16.92	17.41	18.1	18.74	19.22	19.38	19.36	19.03	18.21	17.33	16.64	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.96	18.16	18.57	19.13	19.66	20.08	20.25	20.23	19.9	19.21	18.49	17.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	17.81	18.01	18.42	18.98	19.51	19.93	20.1	20.08	19.75	19.06	18.34	17.78		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.98	0.95	0.89	0.78	0.62	0.67	0.87	0.97	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	315.32	357.71	404.06	446.02	450.04	384.08	290.73	293.81	344.41	331.11	305.21	299.46		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1281.2	1241.22	1125.59	943.25	730.4	494.25	324.86	340.32	525.85	790.86	1054.57	1278.11		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	718.62	593.72	536.82	358	208.59	0	0	0	0	342.06	539.54	728.12		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													4025.45	(98)
Space heating requirement in kWh/m²/year													81.34	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	718.62	593.72	536.82	358	208.59	0	0	0	0	342.06	539.54	728.12		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	794.05	656.04	593.17	395.58	230.48	0	0	0	0	377.96	596.18	804.55		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4448.02	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38		
Efficiency of water heater													87.3	(216)
(217)m=	89.98	89.95	89.88	89.73	89.4	87.3	87.3	87.3	87.3	89.68	89.89	90		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	150.26	131.9	137.27	121.39	118.04	106.01	99.91	112.26	112.88	126.04	135.32	145.99		
Total = Sum(219a)$_{1...12}$ =													1497.25	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4448.02

DER WorkSheet: New dwelling design stage

Water heating fuel used			1497.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	960.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	323.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1284.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1447.27	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		29.24	(273)
EI rating (section 14)				79	(274)

Predicted Energy Assessment

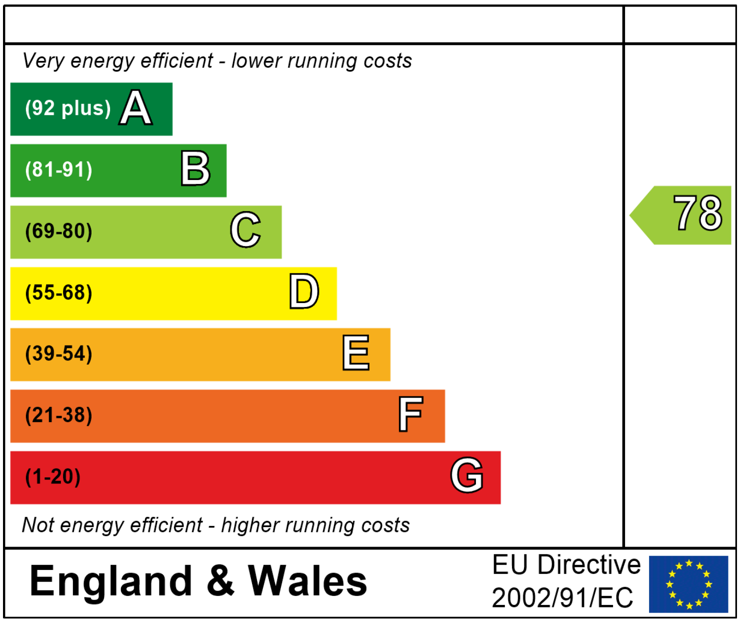
Flat 5
Lawnwood House, Lawnwood Road, Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type: Top floor Flat
Date of assessment: 20 April 2020
Produced by: Benjamin Leech
Total floor area: 49.49 m²

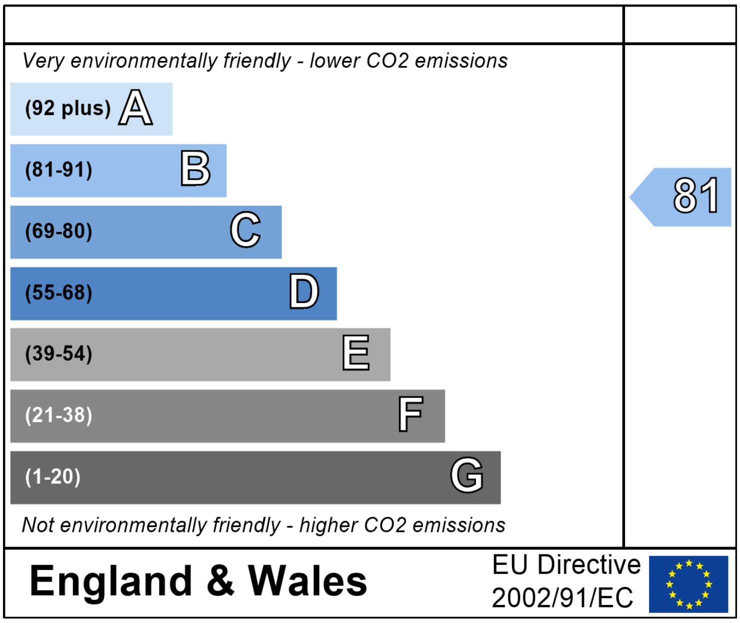
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1…12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1…12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.85	0.73	0.78	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.84	19.02	19.36	19.83	20.3	20.68	20.87	20.83	20.51	19.9	19.29	18.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.75	0.54	0.6	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.49	17.66	18	18.48	18.93	19.27	19.39	19.37	19.13	18.55	17.95	17.47	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.8	0.65	0.71	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.75	332.27	381.09	427.54	437.85	380.89	295.68	295.84	333.79	310.74	280.58	273.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1325.43	1282.38	1160.85	970.33	750.15	509.2	338.6	354.01	542.28	816.39	1090.54	1322.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	771.29	638.47	580.14	390.8	232.35	0	0	0	0	376.21	583.17	780.66	

Total per year (kWh/year) = Sum$(98)_{1...5,9...12}$ = 4353.09 (98)

Space heating requirement in kWh/m²/year 87.96 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	871.62	686.17	703.68	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.63	0.72	0.67	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	548.61	490.85	474.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	50.01	74.64	57.28	0	0	0	0	

Total = Sum$(104)_{6...8}$ = 181.93 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum$(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	12.5	18.66	14.32	0	0	0	0

Total = Sum$(107)_{6...8}$ = 45.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.92 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 88.88 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = Sum(40)$_{1…12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
									Total = Sum(44)$_{1…12}$ =			887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
									Total = Sum(45)$_{1…12}$ =			1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

TFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.84	0.72	0.77	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.94	19.11	19.44	19.91	20.36	20.72	20.89	20.86	20.55	19.96	19.37	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.74	0.53	0.59	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.63	17.8	18.13	18.6	19.03	19.35	19.46	19.45	19.22	18.66	18.07	17.61	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TFEE WorkSheet: New dwelling design stage

(93)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.79	0.64	0.7	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.81	332.35	381.15	427.29	436.34	376.79	289.69	290.92	332.38	310.73	280.65	273.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1272.17	1230.87	1114.41	931.52	720.47	489.12	325.53	340.39	521.22	783.97	1046.57	1269.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	731.62	603.81	545.54	363.05	211.4	0	0	0	0	352.09	551.46	740.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4099.69 (98)

Space heating requirement in kWh/m²/year 82.84 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	828.8	652.46	669.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.66	0.74	0.7	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	544.24	484.39	469.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.16	79.44	60.98	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 193.57 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	13.29	19.86	15.24	0	0	0	0

Total = Sum(107)$_{6...8}$ = 48.39 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.98 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 83.82 (109)

Target Fabric Energy Efficiency (TFEE) 96.39 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9		
											Average = Sum(40)$_{1...12}$ /12=		1.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38		
										Total = Sum(44)$_{1...12}$ =			887.8	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88		
										Total = Sum(45)$_{1...12}$ =			1164.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = — 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.51	13.09	14.46	13.96	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.5	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	

Output from water heater (annual)$_{1…12}$ 1334.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.76	38.37	39.83	35.07	33.9	29.62	27.82	31.4	31.62	36.39	39.29	42.49	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	33.87	30.08	24.46	18.52	13.84	11.69	12.63	16.42	22.03	27.98	32.65	34.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	217.78	220.04	214.34	202.22	186.91	172.53	162.92	160.66	166.36	178.48	193.78	208.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)
Water heating gains (Table 5)													
(72)m=	58.81	57.1	53.54	48.7	45.56	41.14	37.39	42.2	43.91	48.92	54.57	57.11	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	393.68	390.44	375.57	352.67	329.55	308.59	296.17	302.51	315.53	338.6	364.23	383.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	441.64	484.26	530.07	578	605.7	591.28	565.3	533.69	495.22	449.92	424.03	422.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.78	0.64	0.68	0.86	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.09	19.26	19.58	20.02	20.45	20.78	20.92	20.9	20.64	20.1	19.52	19.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.84	0.66	0.44	0.5	0.78	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.96	17.2	17.67	18.31	18.89	19.28	19.39	19.38	19.14	18.43	17.6	16.92	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.2	18.4	18.78	19.31	19.79	20.15	20.28	20.26	20.01	19.4	18.71	18.17	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.05	18.25	18.63	19.16	19.64	20	20.13	20.11	19.86	19.25	18.56	18.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.92	0.85	0.71	0.54	0.59	0.81	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	434.35	472.86	509.07	533.34	513	418.53	304.76	312.95	399.02	421.41	413.43	416.69	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1303.97	1263.33	1145.9	960.2	742.52	500.57	327.44	343.8	536.18	808.29	1075.22	1300.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	647	531.2	473.81	307.34	170.77	0	0	0	0	287.84	476.49	657.47	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3551.9 (98)

Space heating requirement in kWh/m²/year 71.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	647	531.2	473.81	307.34	170.77	0	0	0	0	287.84	476.49	657.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	714.92	586.96	523.54	339.6	188.69	0	0	0	0	318.05	526.51	726.49	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3924.76 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	
Efficiency of water heater												87.3	(216)
(217)m=	89.93	89.9	89.82	89.64	89.25	87.3	87.3	87.3	87.3	89.57	89.83	89.95	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	150.34	131.97	137.37	121.51	118.23	106.01	99.91	112.26	112.88	126.2	135.41	146.06	

Total = Sum(219a)$_{1...12}$ = 1498.15 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3924.76

Water heating fuel used			1498.15	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	136.58	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	52.14	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	31.56	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	350.17	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.56	(257)
SAP rating (Section 12)		78.29	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	847.75	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	323.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1171.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1334.44	(272)
CO2 emissions per m²		(272) ÷ (4) =		26.96	(273)
EI rating (section 14)				81	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	4788.2	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1827.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				6615.95	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	734.48	(268)
'Total Primary Energy			sum of (265)…(271) =		7580.68	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		153.18	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - Baseline

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1\ldots12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81	

Average = Sum(40)$_{1...12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Total = Sum(44)$_{1...12}$ = 887.8 (44)

Total = Sum(45)$_{1...12}$ = 1164.05 (45)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	41.47	36.1	38.46	35.76	35.44	32.84	33.93	35.44	35.76	38.46	38.67	41.47	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35	

Output from water heater (annual)$_{1...12}$ 1607.83 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	50.5	44.12	45.83	40.51	39.16	34.35	32.71	36.66	37.07	42.4	45.46	49.23	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)
Water heating gains (Table 5)													
(72)m=	67.87	65.66	61.6	56.27	52.63	47.71	43.96	49.27	51.49	56.99	63.13	66.17	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	278.45	276.24	266.12	250.29	234.53	219.11	209.3	214.61	222.89	238.89	257.15	270.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	326.41	370.05	420.62	475.62	510.68	501.8	478.43	445.79	402.58	350.21	316.95	310.13	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19	19.17	19.5	19.95	20.4	20.75	20.91	20.87	20.59	20.01	19.43	18.97	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.88	0.72	0.5	0.56	0.84	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.87	17.12	17.6	18.26	18.87	19.31	19.45	19.44	19.14	18.35	17.51	16.84	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.11	18.31	18.7	19.24	19.76	20.14	20.3	20.27	19.98	19.32	18.63	18.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.11	18.31	18.7	19.24	19.76	20.14	20.3	20.27	19.98	19.32	18.63	18.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.77	0.62	0.67	0.87	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	324.3	366.16	411.87	452.83	455.23	387.47	294.41	297.86	350.12	338.71	313.65	308.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.68	1208.13	1096.99	921.31	716.53	488.81	325.89	340.89	520.08	775.17	1028.41	1243.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	686.25	565.8	509.73	337.3	194.41	0	0	0	0	324.72	514.63	695.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3828.25 (98)

Space heating requirement in kWh/m²/year 77.35 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	686.25	565.8	509.73	337.3	194.41	0	0	0	0	324.72	514.63	695.4		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	734.74	605.79	545.75	361.14	208.15	0	0	0	0	347.67	551	744.54		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													4098.77	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35		
Efficiency of water heater													80.3	(216)
(217)m=	88.28	88.18	87.92	87.33	86.13	80.3	80.3	80.3	80.3	87.15	87.95	88.34		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	183.69	160.64	167.63	149.68	146.94	138.81	132.99	148.25	149.89	157.27	166.35	179.25		
Total = Sum(219a)$_{1...12}$ =													1881.38	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4098.77

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Water heating fuel used			1881.38	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	885.33	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	406.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1291.71	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	124.17	(268)
Total CO2, kg/year			sum of (265)…(271) =		1454.8	(272)

TER =	29.4	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:34

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 49.49m²

Site Reference : Lawnwood House **Plot Reference:** Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	29.4 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	25.21 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	96.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	88.9 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: East	2.24m²
Windows facing: West	5.75m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

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Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1\ldots12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1\ldots12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1\ldots12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.51	13.09	14.46	13.96	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.5	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	

Output from water heater (annual)$_{1...12}$ 1334.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.76	38.37	39.83	35.07	33.9	29.62	27.82	31.4	31.62	36.39	39.29	42.49	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	58.81	57.1	53.54	48.7	45.56	41.14	37.39	42.2	43.91	48.92	54.57	57.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.4	267.68	258.06	242.72	227.46	212.54	202.72	207.54	215.31	230.82	248.59	261.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	317.35	361.5	412.56	468.06	503.61	495.23	471.86	438.72	395	342.14	308.39	301.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.93	0.84	0.72	0.76	0.92	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.89	19.06	19.4	19.87	20.33	20.7	20.88	20.85	20.53	19.94	19.33	18.86	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.96	0.89	0.73	0.52	0.58	0.85	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.67	16.92	17.41	18.1	18.74	19.22	19.38	19.36	19.03	18.21	17.33	16.64	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.96	18.16	18.57	19.13	19.66	20.08	20.25	20.23	19.9	19.21	18.49	17.93	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	17.81	18.01	18.42	18.98	19.51	19.93	20.1	20.08	19.75	19.06	18.34	17.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.78	0.62	0.67	0.87	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	315.32	357.71	404.06	446.02	450.04	384.08	290.73	293.81	344.41	331.11	305.21	299.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1281.2	1241.22	1125.59	943.25	730.4	494.25	324.86	340.32	525.85	790.86	1054.57	1278.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	718.62	593.72	536.82	358	208.59	0	0	0	0	342.06	539.54	728.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4025.45 (98)

Space heating requirement in kWh/m²/year 81.34 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	718.62	593.72	536.82	358	208.59	0	0	0	0	342.06	539.54	728.12	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	794.05	656.04	593.17	395.58	230.48	0	0	0	0	377.96	596.18	804.55	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4448.02 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	
Efficiency of water heater												87.3	(216)
(217)m=	89.98	89.95	89.88	89.73	89.4	87.3	87.3	87.3	87.3	89.68	89.89	90	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	150.26	131.9	137.27	121.39	118.04	106.01	99.91	112.26	112.88	126.04	135.32	145.99	

Total = Sum(219a)$_{1...12}$ = 1497.25 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4448.02

Water heating fuel used			1497.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)
Electricity generated by PVs			-384.81	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	960.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	323.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1284.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Energy saving/generation technologies Item 1		0.519	=	-199.72	(269)
Total CO2, kg/year		sum of (265)…(271) =		1247.55	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		25.21	(273)
EI rating (section 14)				82	(274)

Predicted Energy Assessment

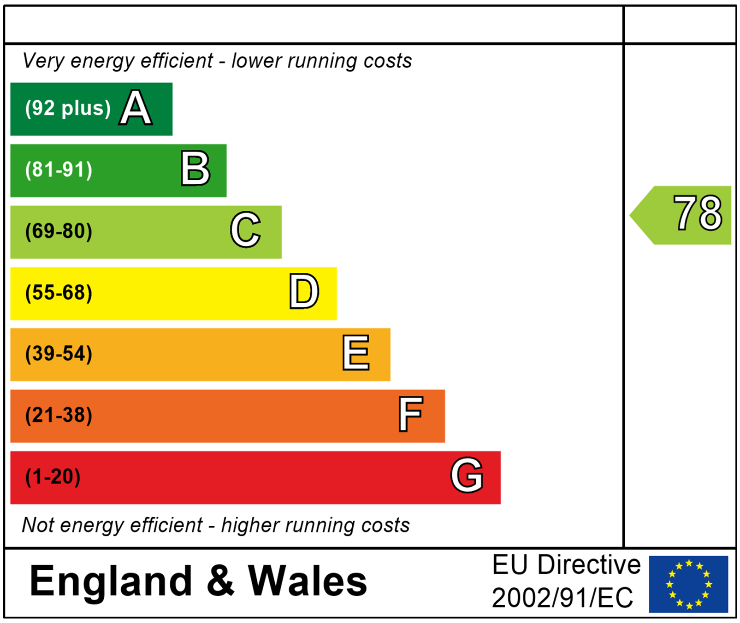
Flat 5
Lawnwood House, Lawnwood Road, Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	49.49 m²

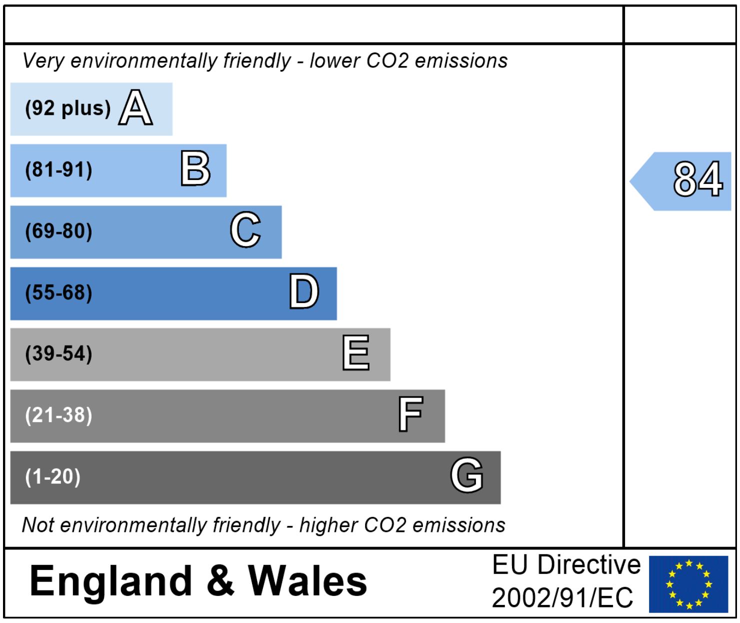
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = Sum(39)$_{1…12}$ /12= 93.62 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9	

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38	

Total = Sum(44)$_{1…12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88	

Total = Sum(45)$_{1…12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.85	0.73	0.78	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.84	19.02	19.36	19.83	20.3	20.68	20.87	20.83	20.51	19.9	19.29	18.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.75	0.54	0.6	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.49	17.66	18	18.48	18.93	19.27	19.39	19.37	19.13	18.55	17.95	17.47	(90)

fLA = Living area ÷ (4) = | 0.58 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.28	18.45	18.79	19.26	19.73	20.09	20.25	20.22	19.93	19.33	18.73	18.25	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.8	0.65	0.71	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.75	332.27	381.09	427.54	437.85	380.89	295.68	295.84	333.79	310.74	280.58	273.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1325.43	1282.38	1160.85	970.33	750.15	509.2	338.6	354.01	542.28	816.39	1090.54	1322.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	771.29	638.47	580.14	390.8	232.35	0	0	0	0	376.21	583.17	780.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4353.09 (98)

Space heating requirement in kWh/m²/year 87.96 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	871.62	686.17	703.68	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.63	0.72	0.67	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	548.61	490.85	474.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	50.01	74.64	57.28	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 181.93 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	12.5	18.66	14.32	0	0	0	0

Total = Sum(107)$_{6...8}$ = 45.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.92 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 88.88 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1\ldots12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = Sum(40)$_{1\ldots12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1\ldots12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1\ldots12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	102.58	89.72	92.58	80.72	77.45	66.83	61.93	71.07	71.92	83.81	91.49	99.35	

Output from water heater (annual)$_{1...12}$ 989.44 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	34.47	33.38	31.11	28.03	26.02	23.21	20.81	23.88	24.97	28.16	31.77	33.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	242.05	240.96	232.63	219.05	204.92	191.6	183.15	186.22	193.37	207.06	222.79	234.9	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	290.01	334.78	387.13	444.38	481.08	474.3	452.28	417.4	373.06	318.38	282.59	274.34	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.84	0.72	0.77	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.94	19.11	19.44	19.91	20.36	20.72	20.89	20.86	20.55	19.96	19.37	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.9	0.74	0.53	0.59	0.87	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.63	17.8	18.13	18.6	19.03	19.35	19.46	19.45	19.22	18.66	18.07	17.61	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.39	18.56	18.89	19.36	19.8	20.15	20.29	20.27	19.99	19.42	18.83	18.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.91	0.79	0.64	0.7	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	288.81	332.35	381.15	427.29	436.34	376.79	289.69	290.92	332.38	310.73	280.65	273.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1272.17	1230.87	1114.41	931.52	720.47	489.12	325.53	340.39	521.22	783.97	1046.57	1269.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	731.62	603.81	545.54	363.05	211.4	0	0	0	0	352.09	551.46	740.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4099.69 (98)

Space heating requirement in kWh/m²/year 82.84 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	828.8	652.46	669.06	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.66	0.74	0.7	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	544.24	484.39	469.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	618.07	591.16	551.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.16	79.44	60.98	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 193.57 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	13.29	19.86	15.24	0	0	0	0

Total = Sum(107)$_{6...8}$ = 48.39 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.98 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 83.82 (109)

Target Fabric Energy Efficiency (TFEE) 96.39 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.43	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 43.62 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 27.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 71.32 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.83	94.65	94.47	93.62	93.46	92.73	92.73	92.59	93.01	93.46	93.78	94.12	

Average = $Sum(39)_{1...12}$ /12= 93.62 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.92	1.91	1.91	1.89	1.89	1.87	1.87	1.87	1.88	1.89	1.89	1.9

Average = Sum(40)$_{1…12}$ /12= 1.89 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = Sum(44)$_{1…12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = Sum(45)$_{1…12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.51	13.09	14.46	13.96	14.41	13.92	14.36	14.39	13.94	14.44	14.01	14.5	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	

Output from water heater (annual)$_{1...12}$ 1334.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	43.76	38.37	39.83	35.07	33.9	29.62	27.82	31.4	31.62	36.39	39.29	42.49	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	100.51	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	33.87	30.08	24.46	18.52	13.84	11.69	12.63	16.42	22.03	27.98	32.65	34.81	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	217.78	220.04	214.34	202.22	186.91	172.53	162.92	160.66	166.36	178.48	193.78	208.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	46.73	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	58.81	57.1	53.54	48.7	45.56	41.14	37.39	42.2	43.91	48.92	54.57	57.11	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	393.68	390.44	375.57	352.67	329.55	308.59	296.17	302.51	315.53	338.6	364.23	383.31	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	441.64	484.26	530.07	578	605.7	591.28	565.3	533.69	495.22	449.92	424.03	422.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.78	0.64	0.68	0.86	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.09	19.26	19.58	20.02	20.45	20.78	20.92	20.9	20.64	20.1	19.52	19.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.39	19.39	19.41	19.41	19.42	19.42	19.42	19.41	19.41	19.4	19.4	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.84	0.66	0.44	0.5	0.78	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.96	17.2	17.67	18.31	18.89	19.28	19.39	19.38	19.14	18.43	17.6	16.92	(90)

fLA = Living area ÷ (4) = | 0.58 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.2	18.4	18.78	19.31	19.79	20.15	20.28	20.26	20.01	19.4	18.71	18.17	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.05	18.25	18.63	19.16	19.64	20	20.13	20.11	19.86	19.25	18.56	18.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.92	0.85	0.71	0.54	0.59	0.81	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	434.35	472.86	509.07	533.34	513	418.53	304.76	312.95	399.02	421.41	413.43	416.69	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1303.97	1263.33	1145.9	960.2	742.52	500.57	327.44	343.8	536.18	808.29	1075.22	1300.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	647	531.2	473.81	307.34	170.77	0	0	0	0	287.84	476.49	657.47	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3551.9 (98)

Space heating requirement in kWh/m²/year 71.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	647	531.2	473.81	307.34	170.77	0	0	0	0	287.84	476.49	657.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	714.92	586.96	523.54	339.6	188.69	0	0	0	0	318.05	526.51	726.49	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3924.76 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	135.2	118.64	123.39	108.93	105.52	92.54	87.22	98	98.55	113.04	121.64	131.38	
Efficiency of water heater												87.3	(216)
(217)m=	89.93	89.9	89.82	89.64	89.25	87.3	87.3	87.3	87.3	89.57	89.83	89.95	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	150.34	131.97	137.37	121.51	118.23	106.01	99.91	112.26	112.88	126.2	135.41	146.06	

Total = Sum(219a)$_{1...12}$ = 1498.15 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3924.76

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Water heating fuel used			1498.15	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			239.24	(232)
Electricity generated by PVs			-384.81	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	136.58	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	52.14	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	31.56	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			350.17	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.56	(257)
SAP rating (Section 12)		78.29	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	847.75	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	323.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1171.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-199.72	(269)

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Total CO2, kg/year	sum of (265)…(271) =	1134.72	(272)
CO2 emissions per m²	(272) ÷ (4) =	22.93	(273)
EI rating (section 14)		84	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	4788.2	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1827.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				6615.95	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	734.48	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1181.36	(269)
'Total Primary Energy			sum of (265)…(271) =		6399.31	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		129.31	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 5 - PV

Address : Flat 5, Lawnwood House, Lawnwood Road, Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	49.49	(1a)	x	2.3	(2a)	=	113.83	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	49.49	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			113.83	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			2.24	x1/[1/(1.4)+ 0.04]		=	2.97			(27)
Windows Type 2			5.75	x1/[1/(1.4)+ 0.04]		=	7.62			(27)
Floor			49.49	x	0.13	=	6.4337			(28)
Walls	100.11	10.2	89.91	x	0.18	=	16.18			(29)
Roof	49.49	0	49.49	x	0.13	=	6.43			(30)
Total area of elements, m²			199.09							(31)
Party wall			30.82	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8216.71 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 24.91 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.76 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.52	23.33	23.15	22.31	22.15	21.41	21.41	21.27	21.69	22.15	22.47	22.8	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	90.28	90.09	89.91	89.07	88.91	88.17	88.17	88.03	88.45	88.91	89.23	89.56	

Average = Sum(39)$_{1…12}$ /12= 89.07 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.82	1.82	1.8	1.8	1.78	1.78	1.78	1.79	1.8	1.8	1.81

Average = $Sum(40)_{1...12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.68 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 73.98 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	81.38	78.42	75.46	72.5	69.54	66.59	66.59	69.54	72.5	75.46	78.42	81.38

Total = $Sum(44)_{1...12}$ = 887.8 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	120.69	105.55	108.92	94.96	91.12	78.63	72.86	83.61	84.61	98.6	107.63	116.88

Total = $Sum(45)_{1...12}$ = 1164.05 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.1	15.83	16.34	14.24	13.67	11.79	10.93	12.54	12.69	14.79	16.14	17.53

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	41.47	36.1	38.46	35.76	35.44	32.84	33.93	35.44	35.76	38.46	38.67	41.47	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35	

Output from water heater (annual)$_{1...12}$ 1607.83 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	50.5	44.12	45.83	40.51	39.16	34.35	32.71	36.66	37.07	42.4	45.46	49.23	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	83.75	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	145.91	147.42	143.61	135.49	125.23	115.6	109.16	107.64	111.46	119.58	129.83	139.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	31.38	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	-67	(71)

Water heating gains (Table 5)

(72)m=	67.87	65.66	61.6	56.27	52.63	47.71	43.96	49.27	51.49	56.99	63.13	66.17	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	278.45	276.24	266.12	250.29	234.53	219.11	209.3	214.61	222.89	238.89	257.15	270.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)

East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
West	0.9x	0.77	x	5.75	x	19.64	x	0.63	x	0.7	=	34.51	(80)
West	0.9x	0.77	x	5.75	x	38.42	x	0.63	x	0.7	=	67.52	(80)
West	0.9x	0.77	x	5.75	x	63.27	x	0.63	x	0.7	=	111.19	(80)
West	0.9x	0.77	x	5.75	x	92.28	x	0.63	x	0.7	=	162.16	(80)
West	0.9x	0.77	x	5.75	x	113.09	x	0.63	x	0.7	=	198.73	(80)
West	0.9x	0.77	x	5.75	x	115.77	x	0.63	x	0.7	=	203.44	(80)
West	0.9x	0.77	x	5.75	x	110.22	x	0.63	x	0.7	=	193.68	(80)
West	0.9x	0.77	x	5.75	x	94.68	x	0.63	x	0.7	=	166.37	(80)
West	0.9x	0.77	x	5.75	x	73.59	x	0.63	x	0.7	=	129.32	(80)
West	0.9x	0.77	x	5.75	x	45.59	x	0.63	x	0.7	=	80.11	(80)
West	0.9x	0.77	x	5.75	x	24.49	x	0.63	x	0.7	=	43.03	(80)
West	0.9x	0.77	x	5.75	x	16.15	x	0.63	x	0.7	=	28.38	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	47.96	93.82	154.5	225.33	276.16	282.69	269.14	231.18	179.69	111.32	59.8	39.44	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	326.41	370.05	420.62	475.62	510.68	501.8	478.43	445.79	402.58	350.21	316.95	310.13	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19	19.17	19.5	19.95	20.4	20.75	20.91	20.87	20.59	20.01	19.43	18.97	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.45	19.46	19.46	19.47	19.47	19.48	19.48	19.48	19.48	19.47	19.47	19.46	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.88	0.72	0.5	0.56	0.84	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.87	17.12	17.6	18.26	18.87	19.31	19.45	19.44	19.14	18.35	17.51	16.84	(90)

fLA = Living area ÷ (4) = 0.58 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.11	18.31	18.7	19.24	19.76	20.14	20.3	20.27	19.98	19.32	18.63	18.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.11	18.31	18.7	19.24	19.76	20.14	20.3	20.27	19.98	19.32	18.63	18.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.77	0.62	0.67	0.87	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	324.3	366.16	411.87	452.83	455.23	387.47	294.41	297.86	350.12	338.71	313.65	308.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1246.68	1208.13	1096.99	921.31	716.53	488.81	325.89	340.89	520.08	775.17	1028.41	1243.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	686.25	565.8	509.73	337.3	194.41	0	0	0	0	324.72	514.63	695.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3828.25 (98)

Space heating requirement in kWh/m²/year 77.35 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	686.25	565.8	509.73	337.3	194.41	0	0	0	0	324.72	514.63	695.4	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	734.74	605.79	545.75	361.14	208.15	0	0	0	0	347.67	551	744.54	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4098.77 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	162.16	141.65	147.38	130.72	126.56	111.46	106.79	119.05	120.36	137.06	146.3	158.35	
Efficiency of water heater												80.3	(216)
(217)m=	88.28	88.18	87.92	87.33	86.13	80.3	80.3	80.3	80.3	87.15	87.95	88.34	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	183.69	160.64	167.63	149.68	146.94	138.81	132.99	148.25	149.89	157.27	166.35	179.25	

Total = Sum(219a)$_{1...12}$ = 1881.38 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4098.77

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Water heating fuel used		1881.38	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		239.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	885.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	406.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1291.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1454.8	(272)

TER =	29.4	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:13

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 59.94m²

Site Reference : Lawnwood House **Plot Reference:** Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	32.39 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	23.05 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.51 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Heat pumps with radiators or underfloor heating - electric
Air source heat pump with flow temperature <= 35°C

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services		**OK**
Hot water controls:	Cylinderstat		**OK**
	Independent timer for DHW		**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.54m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.94	(1a) x	2.3	(2a) =	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	

Output from water heater (annual)$_{1...12}$ 2005.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.47	83.16	89.17	82.48	82.67	76.52	76.01	79.93	78.7	85.4	87.11	92.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)
Water heating gains (Table 5)													
(72)m=	125.63	123.75	119.86	114.56	111.12	106.28	102.16	107.43	109.31	114.79	120.98	123.76	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	372.2	370.1	358.68	340.6	322.52	305.11	293.87	299.38	308.77	327.04	347.87	363.21	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	405.46	435.15	465.81	496.83	513.99	501.12	480.48	459.67	433.36	404.23	389.33	390.56	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.93	0.81	0.65	0.69	0.89	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.76	19.99	20.33	20.64	20.88	20.97	20.96	20.79	20.39	19.96	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.89	0.72	0.5	0.55	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.23	18.57	19.06	19.5	19.79	19.86	19.86	19.69	19.16	18.54	18.03	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	18.98	19.27	19.68	20.06	20.33	20.41	20.4	20.23	19.76	19.24	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	18.98	19.27	19.68	20.06	20.33	20.41	20.4	20.23	19.76	19.24	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.9	0.76	0.57	0.62	0.85	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	403.04	431.24	457.85	476.67	461.71	379.54	275.92	285.1	368.58	390.11	385.25	388.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.21	1089.42	985.73	822.62	636.58	431.53	286.83	300.72	464.08	697.76	928.28	1122.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	538.78	442.3	392.74	249.09	130.11	0	0	0	0	228.89	390.98	546.11	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2919	(98)
Space heating requirement in kWh/m²/year	48.7	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	538.78	442.3	392.74	249.09	130.11	0	0	0	0	228.89	390.98	546.11		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	215.6	176.99	157.16	99.68	52.06	0	0	0	0	91.59	156.45	218.53		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1168.07	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	110.94	98.04	103.57	93.68	92.4	83.43	80.96	87.69	87.18	97.1	101.62	108.56		
Total = Sum(219a)$_{1...12}$ =													1145.17	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1168.07	
Water heating fuel used			1145.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	606.23	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

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Water heating	(219) x	0.519	=	594.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1200.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1381.86	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.05	(273)
EI rating (section 14)				82	(274)

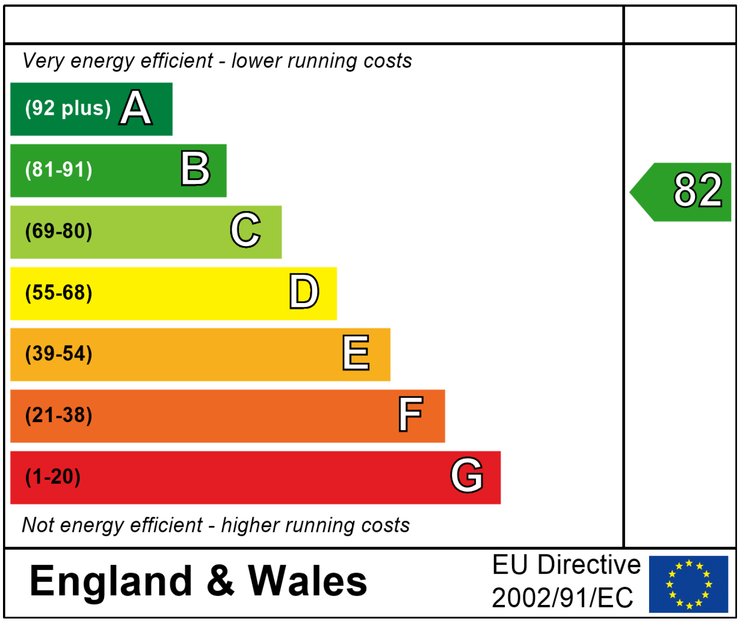
Predicted Energy Assessment

Flat 6 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Top floor Flat Date of assessment: 20 April 2020 Produced by: Benjamin Leech Total floor area: 59.94 m²

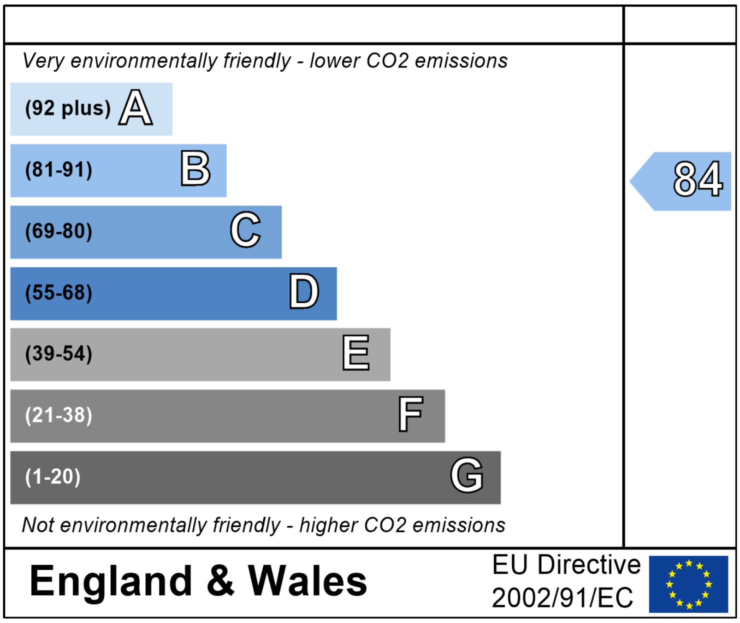
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83

Average = Sum(39)$_{1\ldots12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28		
Average = Sum(40)$_{1…12}$ /12=													1.27	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35		
Total = Sum(44)$_{1…12}$ =													974.68	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32		
Total = Sum(45)$_{1…12}$ =													1277.96	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1…12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.62	19.86	20.21	20.54	20.82	20.94	20.92	20.7	20.27	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.8	0.59	0.65	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.61	18.85	19.2	19.53	19.78	19.86	19.85	19.68	19.26	18.82	18.47	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.67	0.72	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.04	343.87	374.35	401.76	403.18	348.52	265.64	270.31	319.38	312.83	299.16	299.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1139.06	1099.24	991.65	823.52	634.01	428.95	285.77	299.23	460.38	697.21	934.42	1134.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	613.82	507.61	459.27	303.66	171.74	0	0	0	0	285.98	457.39	621.08	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3420.55 (98)

Space heating requirement in kWh/m²/year 57.07 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.52	557.77	571.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.78	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	508.92	451.67	444.75	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	38.91	65.14	51.68	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 155.72 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	9.73	16.28	12.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 38.93 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.65 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 57.72 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

TFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1...12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1...12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1...12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

TFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.72	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.7	19.93	20.26	20.59	20.85	20.96	20.94	20.74	20.32	19.9	19.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.79	0.58	0.64	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.72	18.95	19.29	19.61	19.84	19.91	19.9	19.75	19.35	18.93	18.59	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.82	0.65	0.7	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.07	343.9	374.35	401.49	401.68	343.84	258.75	264.27	317.53	312.74	299.19	299.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.54	1055.26	952.06	790.49	608.79	411.8	274.48	287.43	442.28	669.41	896.77	1088.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	579.92	478.03	429.81	280.08	154.09	0	0	0	0	265.37	430.26	586.95	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3204.51 | (98)

Space heating requirement in kWh/m²/year | 53.46 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	674.88	531.29	544.57	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.75	0.84	0.81	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	503.95	443.94	438.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	42.49	70.89	56.39	0	0	0	0	

Total = Sum(104)$_{6...8}$ = | 169.77 | (104)

Cooled fraction — f C = cooled area ÷ (4) = | 1 | (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = | 0 | (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.62	17.72	14.1	0	0	0	0

Total = Sum(107)$_{6...8}$ = | 42.44 | (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 0.71 | (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = | 54.17 | (109)

Target Fabric Energy Efficiency (TFEE) | 62.3 | (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	28.77	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	184179.81	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		21.12	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.89	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83

Average = $Sum(39)_{1…12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 2.3 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 1.24 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	

Output from water heater (annual)$_{1\ldots12}$ 2005.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.47	83.16	89.17	82.48	82.67	76.52	76.01	79.93	78.7	85.4	87.11	92.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	45.2	40.15	32.65	24.72	18.48	15.6	16.86	21.91	29.41	37.34	43.58	46.46	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	257.9	260.58	253.84	239.48	221.36	204.32	192.94	190.27	197.01	211.37	229.49	246.52	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	125.63	123.75	119.86	114.56	111.12	106.28	102.16	107.43	109.31	114.79	120.98	123.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	520.19	515.94	497.8	470.21	442.41	417.66	403.42	411.07	427.18	454.95	485.51	508.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	553.44	580.99	604.93	626.45	633.89	613.67	590.03	571.36	551.78	532.14	526.97	535.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.87	0.71	0.54	0.58	0.8	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.97	20.19	20.49	20.76	20.93	20.98	20.98	20.88	20.55	20.16	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.92	0.81	0.62	0.41	0.45	0.72	0.92	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.37	18.53	18.85	19.28	19.63	19.83	19.87	19.87	19.78	19.38	18.82	18.34	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.24	19.51	19.87	20.18	20.37	20.42	20.41	20.32	19.95	19.48	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.24	19.51	19.87	20.18	20.37	20.42	20.41	20.32	19.95	19.48	19.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.96	0.92	0.83	0.66	0.48	0.52	0.75	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.11	566.35	580.01	575.38	526.39	405.5	282.49	294.59	415.06	489.1	510.86	526.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1147.99	1109.48	1003.91	837.17	645.82	434.94	287.68	301.95	470.43	712.29	946.77	1142.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	450.03	364.98	315.38	188.49	88.85	0	0	0	0	166.06	313.86	458.42	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2346.06 (98)
Space heating requirement in kWh/m²/year	39.14 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	450.03	364.98	315.38	188.49	88.85	0	0	0	0	166.06	313.86	458.42		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	180.08	146.05	126.2	75.43	35.56	0	0	0	0	66.45	125.59	183.44		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													938.8	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	110.94	98.04	103.57	93.68	92.4	83.43	80.96	87.69	87.18	97.1	101.62	108.56		
Total = Sum(219a)$_{1...12}$ =													1145.17	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			938.8	
Water heating fuel used			1145.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			319.3	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	123.83	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)

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Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	151.05	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.12	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	320.95	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.08	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	487.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	594.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1081.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1262.87	(272)
CO2 emissions per m²		(272) ÷ (4) =		21.07	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2882.12	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3515.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6397.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	980.25	(268)
'Total Primary Energy		sum of (265)…(271) =		7470.14	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		124.63	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06	

Output from water heater (annual)$_{1\ldots12}$ | 1887.24 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	85.45	75.92	81.16	74.73	74.66	68.76	67.99	71.92	70.95	77.39	79.35	84.06	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	114.86	112.98	109.08	103.79	100.35	95.51	91.39	96.66	98.54	104.02	110.21	112.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	361.43	359.33	347.91	329.82	311.75	294.34	283.1	288.6	297.99	316.27	337.1	352.44	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	394.68	424.38	455.04	486.06	503.22	490.35	469.71	448.9	422.59	393.46	378.56	379.79	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.8	0.64	0.68	0.89	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.7	19.82	20.05	20.37	20.68	20.9	20.97	20.96	20.81	20.43	20.01	19.68	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.89	0.71	0.5	0.55	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.17	18.35	18.68	19.15	19.58	19.85	19.91	19.91	19.76	19.24	18.64	18.15	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.07	19.35	19.75	20.12	20.36	20.43	20.43	20.28	19.82	19.32	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.07	19.35	19.75	20.12	20.36	20.43	20.43	20.28	19.82	19.32	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.9	0.75	0.57	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	392.59	420.91	447.74	466.82	451.74	368.9	266.39	275.59	359.15	380.37	374.97	378.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1082.03	1045.67	946.09	789.21	610.69	413.75	275.23	288.52	445.18	669.36	890.52	1077.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	512.94	419.84	370.78	232.12	118.26	0	0	0	0	215.01	371.19	520.07	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2760.2	(98)
Space heating requirement in kWh/m²/year	46.05	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	512.94	419.84	370.78	232.12	118.26	0	0	0	0	215.01	371.19	520.07		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	548.6	449.02	396.55	248.25	126.48	0	0	0	0	229.96	397	556.22		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2952.08	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06		
Efficiency of water heater													79.8	(216)
(217)m=	87.4	87.23	86.82	85.9	84.16	79.8	79.8	79.8	79.8	85.6	86.87	87.48		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	210.8	186.42	197.33	179.66	180.35	170.93	165.08	179.87	179.15	186.9	193.67	205.83		
Total = Sum(219a)$_{1...12}$ =													2236	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2952.08	
Water heating fuel used			2236	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	637.65	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	482.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1120.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1325.27	(272)

TER = 32.39 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:04

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 59.94m²

Site Reference : Lawnwood House **Plot Reference:** Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	32.39 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.55 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.51 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Heat pumps with radiators or underfloor heating - electric
Air source heat pump with flow temperature <= 35°C

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	**OK**
Primary pipework insulated:	Yes	**OK**

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.54m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	

Output from water heater (annual)$_{1...12}$ 2005.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.47	83.16	89.17	82.48	82.67	76.52	76.01	79.93	78.7	85.4	87.11	92.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)
Water heating gains (Table 5)													
(72)m=	125.63	123.75	119.86	114.56	111.12	106.28	102.16	107.43	109.31	114.79	120.98	123.76	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	372.2	370.1	358.68	340.6	322.52	305.11	293.87	299.38	308.77	327.04	347.87	363.21	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	405.46	435.15	465.81	496.83	513.99	501.12	480.48	459.67	433.36	404.23	389.33	390.56	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.93	0.81	0.65	0.69	0.89	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.76	19.99	20.33	20.64	20.88	20.97	20.96	20.79	20.39	19.96	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.89	0.72	0.5	0.55	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.23	18.57	19.06	19.5	19.79	19.86	19.86	19.69	19.16	18.54	18.03	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	18.98	19.27	19.68	20.06	20.33	20.41	20.4	20.23	19.76	19.24	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.83	18.98	19.27	19.68	20.06	20.33	20.41	20.4	20.23	19.76	19.24	18.81	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.9	0.76	0.57	0.62	0.85	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	403.04	431.24	457.85	476.67	461.71	379.54	275.92	285.1	368.58	390.11	385.25	388.6	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.21	1089.42	985.73	822.62	636.58	431.53	286.83	300.72	464.08	697.76	928.28	1122.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	538.78	442.3	392.74	249.09	130.11	0	0	0	0	228.89	390.98	546.11	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2919 (98)

Space heating requirement in kWh/m²/year 48.7 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 249.9 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	538.78	442.3	392.74	249.09	130.11	0	0	0	0	228.89	390.98	546.11		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	215.6	176.99	157.16	99.68	52.06	0	0	0	0	91.59	156.45	218.53		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1168.07	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	110.94	98.04	103.57	93.68	92.4	83.43	80.96	87.69	87.18	97.1	101.62	108.56		
Total = Sum(219a)$_{1...12}$ =													1145.17	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1168.07	
Water heating fuel used			1145.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			319.3	(232)
Electricity generated by PVs			-635.77	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	606.23	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	594.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1200.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-329.97	(269)
Total CO2, kg/year	sum of (265)…(271) =			1051.89	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.55	(273)
EI rating (section 14)				87	(274)

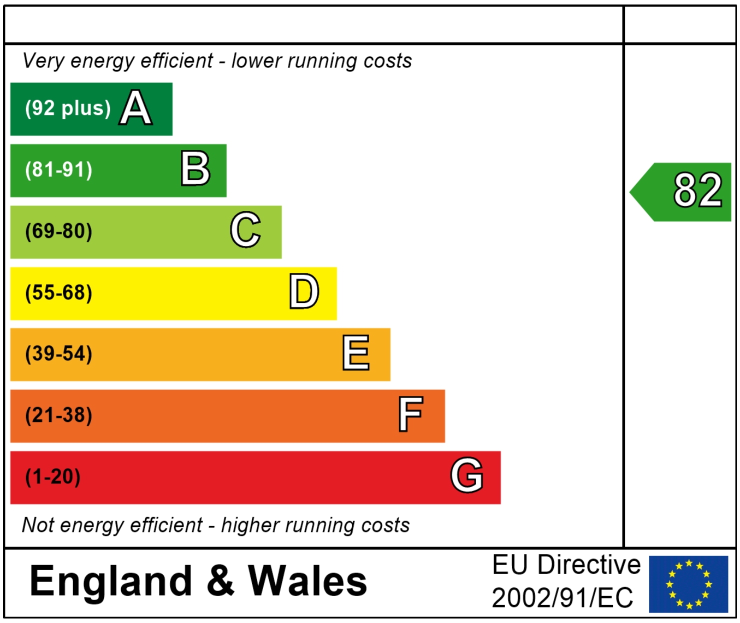
Predicted Energy Assessment

Flat 6 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Top floor Flat Date of assessment: 20 April 2020 Produced by: Benjamin Leech Total floor area: 59.94 m²

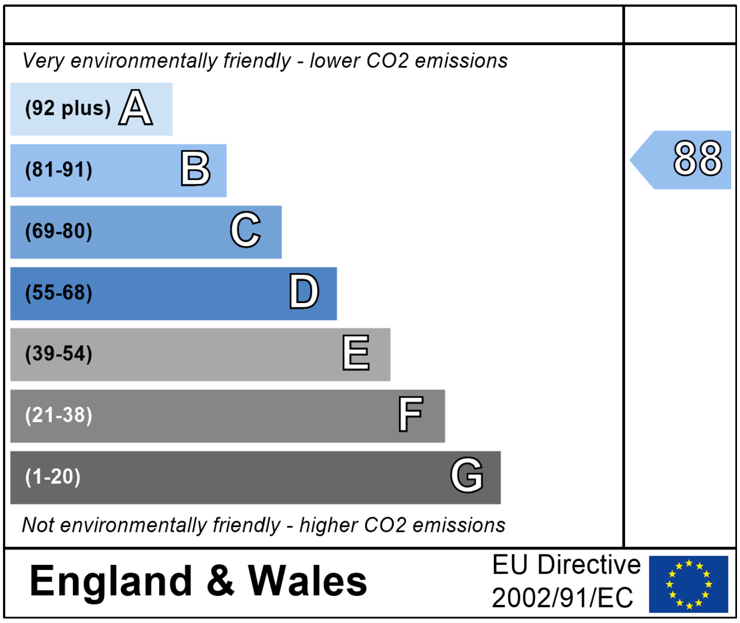
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.62	19.86	20.21	20.54	20.82	20.94	20.92	20.7	20.27	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.8	0.59	0.65	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.61	18.85	19.2	19.53	19.78	19.86	19.85	19.68	19.26	18.82	18.47	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.67	0.72	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.04	343.87	374.35	401.76	403.18	348.52	265.64	270.31	319.38	312.83	299.16	299.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1139.06	1099.24	991.65	823.52	634.01	428.95	285.77	299.23	460.38	697.21	934.42	1134.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	613.82	507.61	459.27	303.66	171.74	0	0	0	0	285.98	457.39	621.08	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3420.55 (98)

Space heating requirement in kWh/m²/year 57.07 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.52	557.77	571.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.78	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	508.92	451.67	444.75	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	38.91	65.14	51.68	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 155.72 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	9.73	16.28	12.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 38.93 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.65 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 57.72 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ | 1086.27 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.72	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.7	19.93	20.26	20.59	20.85	20.96	20.94	20.74	20.32	19.9	19.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.79	0.58	0.64	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.72	18.95	19.29	19.61	19.84	19.91	19.9	19.75	19.35	18.93	18.59	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.82	0.65	0.7	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.07	343.9	374.35	401.49	401.68	343.84	258.75	264.27	317.53	312.74	299.19	299.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.54	1055.26	952.06	790.49	608.79	411.8	274.48	287.43	442.28	669.41	896.77	1088.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	579.92	478.03	429.81	280.08	154.09	0	0	0	0	265.37	430.26	586.95	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	3204.51	(98)
Space heating requirement in kWh/m²/year	53.46	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	674.88	531.29	544.57	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.75	0.84	0.81	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	503.95	443.94	438.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	42.49	70.89	56.39	0	0	0	0	

	Total = $Sum(104)_{6...8}$ =	169.77	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.62	17.72	14.1	0	0	0	0

	Total = $Sum(107)_{6...8}$ =	42.44	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.71	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	54.17	(109)
Target Fabric Energy Efficiency (TFEE)		62.3	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28	
									Average = Sum(40)$_{1…12}$ /12=			1.27	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35		
									Total = Sum(44)$_{1…12}$ =				974.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32		
									Total = Sum(45)$_{1…12}$ =				1277.96	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08	

Output from water heater (annual)$_{1...12}$ 2005.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.47	83.16	89.17	82.48	82.67	76.52	76.01	79.93	78.7	85.4	87.11	92.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	45.2	40.15	32.65	24.72	18.48	15.6	16.86	21.91	29.41	37.34	43.58	46.46	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	257.9	260.58	253.84	239.48	221.36	204.32	192.94	190.27	197.01	211.37	229.49	246.52	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	125.63	123.75	119.86	114.56	111.12	106.28	102.16	107.43	109.31	114.79	120.98	123.76	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	520.19	515.94	497.8	470.21	442.41	417.66	403.42	411.07	427.18	454.95	485.51	508.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	553.44	580.99	604.93	626.45	633.89	613.67	590.03	571.36	551.78	532.14	526.97	535.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.87	0.71	0.54	0.58	0.8	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.97	20.19	20.49	20.76	20.93	20.98	20.98	20.88	20.55	20.16	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.92	0.81	0.62	0.41	0.45	0.72	0.92	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.37	18.53	18.85	19.28	19.63	19.83	19.87	19.87	19.78	19.38	18.82	18.34	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.24	19.51	19.87	20.18	20.37	20.42	20.41	20.32	19.95	19.48	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.24	19.51	19.87	20.18	20.37	20.42	20.41	20.32	19.95	19.48	19.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.96	0.92	0.83	0.66	0.48	0.52	0.75	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.11	566.35	580.01	575.38	526.39	405.5	282.49	294.59	415.06	489.1	510.86	526.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1147.99	1109.48	1003.91	837.17	645.82	434.94	287.68	301.95	470.43	712.29	946.77	1142.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	450.03	364.98	315.38	188.49	88.85	0	0	0	0	166.06	313.86	458.42	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2346.06	(98)
Space heating requirement in kWh/m²/year	39.14	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	450.03	364.98	315.38	188.49	88.85	0	0	0	0	166.06	313.86	458.42		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	180.08	146.05	126.2	75.43	35.56	0	0	0	0	66.45	125.59	183.44		(211)
Total (kWh/year) = $Sum(211)_{1...5,10...12}$ =													938.8	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) = $Sum(215)_{1...5,10...12}$ =													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	194.26	171.67	181.35	164.03	161.8	146.09	141.75	153.55	152.66	170.01	177.93	190.08		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	110.94	98.04	103.57	93.68	92.4	83.43	80.96	87.69	87.18	97.1	101.62	108.56		
Total = $Sum(219a)_{1...12}$ =													1145.17	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			938.8	
Water heating fuel used			1145.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			319.3	(232)
Electricity generated by PVs			-635.77	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	13.19	x 0.01 =	123.83	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	151.05	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	42.12	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			320.95	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.08	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	487.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	594.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1081.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-329.97	(269)
Total CO2, kg/year		sum of (265)…(271) =		932.9	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.56	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2882.12	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3515.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6397.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)

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Electricity for lighting	(232) x	0	=	980.25	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1951.82	(269)
'Total Primary Energy	sum of (265)…(271) =			5518.32	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			92.06	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - ASHP + PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22	

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35	

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32	

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06	

Output from water heater (annual)$_{1...12}$ 1887.24 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	85.45	75.92	81.16	74.73	74.66	68.76	67.99	71.92	70.95	77.39	79.35	84.06	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	114.86	112.98	109.08	103.79	100.35	95.51	91.39	96.66	98.54	104.02	110.21	112.99	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	361.43	359.33	347.91	329.82	311.75	294.34	283.1	288.6	297.99	316.27	337.1	352.44	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	394.68	424.38	455.04	486.06	503.22	490.35	469.71	448.9	422.59	393.46	378.56	379.79	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.8	0.64	0.68	0.89	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.7	19.82	20.05	20.37	20.68	20.9	20.97	20.96	20.81	20.43	20.01	19.68	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.89	0.71	0.5	0.55	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.17	18.35	18.68	19.15	19.58	19.85	19.91	19.91	19.76	19.24	18.64	18.15	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.07	19.35	19.75	20.12	20.36	20.43	20.43	20.28	19.82	19.32	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.07	19.35	19.75	20.12	20.36	20.43	20.43	20.28	19.82	19.32	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.9	0.75	0.57	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	392.59	420.91	447.74	466.82	451.74	368.9	266.39	275.59	359.15	380.37	374.97	378.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1082.03	1045.67	946.09	789.21	610.69	413.75	275.23	288.52	445.18	669.36	890.52	1077.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	512.94	419.84	370.78	232.12	118.26	0	0	0	0	215.01	371.19	520.07	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2760.2 (98)

Space heating requirement in kWh/m²/year 46.05 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	512.94	419.84	370.78	232.12	118.26	0	0	0	0	215.01	371.19	520.07		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	548.6	449.02	396.55	248.25	126.48	0	0	0	0	229.96	397	556.22		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2952.08	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	184.24	162.62	171.33	154.33	151.78	136.4	131.74	143.54	142.96	160	168.24	180.06		
Efficiency of water heater													79.8	(216)
(217)m=	87.4	87.23	86.82	85.9	84.16	79.8	79.8	79.8	79.8	85.6	86.87	87.48		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	210.8	186.42	197.33	179.66	180.35	170.93	165.08	179.87	179.15	186.9	193.67	205.83		
Total = Sum(219a)$_{1...12}$ =													2236	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2952.08	
Water heating fuel used		2236	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	637.65	(261)

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Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	482.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1120.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =			1325.27	(272)

TER =	32.39	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:33:24

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 59.94m²

Site Reference : Lawnwood House **Plot Reference:** Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	22.27 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.35 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.51 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: West	5.54m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35	
										Total = Sum(44)$_{1…12}$ =		974.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32	
										Total = Sum(45)$_{1…12}$ =		1277.96	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.51	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.06	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	

Output from water heater (annual)$_{1...12}$ 1448.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.7	41.82	43.39	38.17	36.87	32.19	30.19	34.13	34.38	39.61	42.8	46.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	64.11	62.23	58.32	53.01	49.56	44.71	40.58	45.87	47.75	53.25	59.45	62.24	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	310.69	308.57	297.15	279.05	260.96	243.54	232.3	237.81	247.21	265.5	286.34	301.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.94	373.62	404.28	435.28	452.43	439.55	418.91	398.11	371.8	342.68	327.8	329.04	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.86	0.72	0.76	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.67	19.9	20.24	20.57	20.84	20.95	20.93	20.73	20.31	19.87	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.62	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.09	18.44	18.94	19.41	19.75	19.85	19.85	19.63	19.04	18.4	17.9	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.72	18.87	19.16	19.58	19.98	20.29	20.39	20.38	20.17	19.66	19.12	18.7	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.57	18.72	19.01	19.43	19.83	20.14	20.24	20.23	20.02	19.51	18.97	18.55	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.8	0.62	0.67	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.81	371.66	399.94	423.27	418.23	352.47	260.2	267.36	331.15	335.42	325.92	328.16	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1106.7	1069.04	965.61	803.39	619.11	417.27	274.6	288.15	447.85	678.37	908.14	1102.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	568.34	468.64	420.86	273.69	149.46	0	0	0	0	255.16	419.2	575.94	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3131.27	(98)
Space heating requirement in kWh/m²/year	52.24	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	568.34	468.64	420.86	273.69	149.46	0	0	0	0	255.16	419.2	575.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	607.85	501.22	450.12	292.71	159.85	0	0	0	0	272.9	448.34	615.97		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3348.95	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88		
Efficiency of water heater													87.3	(216)
(217)m=	89.82	89.79	89.71	89.51	89.08	87.3	87.3	87.3	87.3	89.44	89.71	89.85		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	163.73	143.7	149.48	132.12	128.51	114.86	108.11	121.67	122.41	137.23	147.39	159.03		
Total = Sum(219a)$_{1...12}$ =													1628.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3348.95	
Water heating fuel used			1628.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	723.37	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	351.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1075.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1279.71	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.35	(273)
EI rating (section 14)				84	(274)

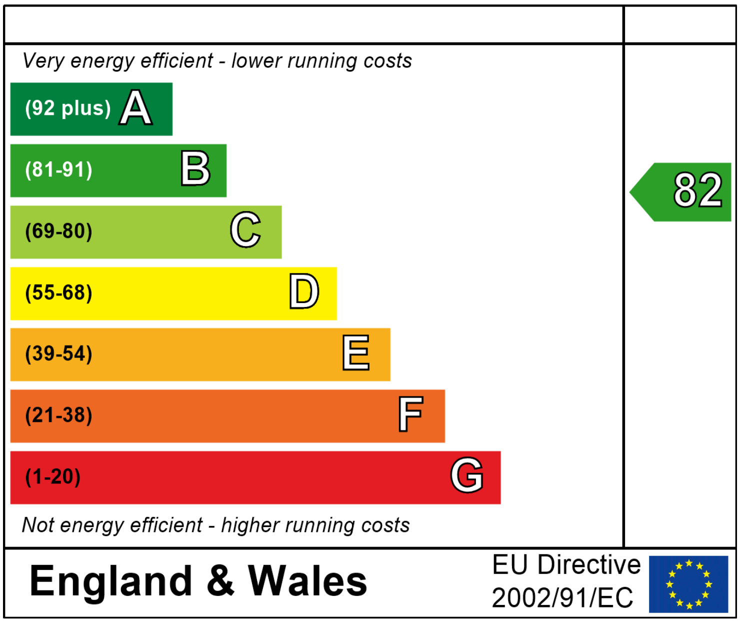
Predicted Energy Assessment

Flat 6		Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate		Date of assessment:	20 April 2020
Lawnwood Road		Produced by:	Benjamin Leech
Bristol		Total floor area:	59.94 m²
BS5 0EF			

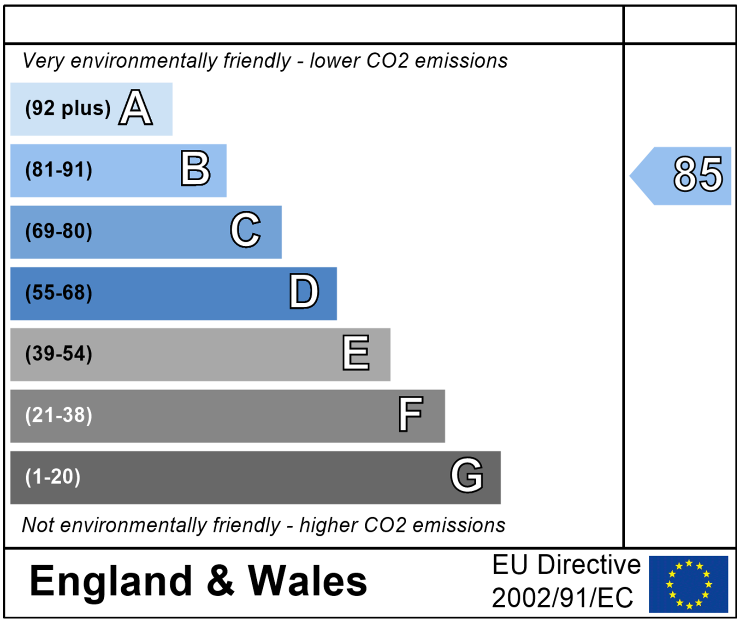
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.94	(1a) x	2.3	(2a) =	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1...12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1...12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.62	19.86	20.21	20.54	20.82	20.94	20.92	20.7	20.27	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.8	0.59	0.65	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.61	18.85	19.2	19.53	19.78	19.86	19.85	19.68	19.26	18.82	18.47	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.67	0.72	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.04	343.87	374.35	401.76	403.18	348.52	265.64	270.31	319.38	312.83	299.16	299.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1139.06	1099.24	991.65	823.52	634.01	428.95	285.77	299.23	460.38	697.21	934.42	1134.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	613.82	507.61	459.27	303.66	171.74	0	0	0	0	285.98	457.39	621.08	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	3420.55	(98)
Space heating requirement in kWh/m²/year	57.07	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.52	557.77	571.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.78	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	508.92	451.67	444.75	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	38.91	65.14	51.68	0	0	0	0	

	Total = $Sum(104)_{6..8}$ =	155.72	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6..8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	9.73	16.28	12.92	0	0	0	0

	Total = $Sum(107)_{6..8}$ =	38.93	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.65	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	57.72	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1\ldots12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1\ldots12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1\ldots12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.72	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.7	19.93	20.26	20.59	20.85	20.96	20.94	20.74	20.32	19.9	19.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.79	0.58	0.64	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.72	18.95	19.29	19.61	19.84	19.91	19.9	19.75	19.35	18.93	18.59	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.82	0.65	0.7	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.07	343.9	374.35	401.49	401.68	343.84	258.75	264.27	317.53	312.74	299.19	299.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.54	1055.26	952.06	790.49	608.79	411.8	274.48	287.43	442.28	669.41	896.77	1088.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	579.92	478.03	429.81	280.08	154.09	0	0	0	0	265.37	430.26	586.95	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3204.51 (98)

Space heating requirement in kWh/m²/year 53.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	674.88	531.29	544.57	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.75	0.84	0.81	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	503.95	443.94	438.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	42.49	70.89	56.39	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 169.77 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.62	17.72	14.1	0	0	0	0

Total = Sum(107)$_{6...8}$ = 42.44 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.71 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 54.17 (109)

Target Fabric Energy Efficiency (TFEE) 62.3 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.94	(1a) x	2.3	(2a) =	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1…12}$ /12= 76.31 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1...12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1...12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.51	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.06	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	

Output from water heater (annual)$_{1...12}$ 1448.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.7	41.82	43.39	38.17	36.87	32.19	30.19	34.13	34.38	39.61	42.8	46.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.2	40.15	32.65	24.72	18.48	15.6	16.86	21.91	29.41	37.34	43.58	46.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	257.9	260.58	253.84	239.48	221.36	204.32	192.94	190.27	197.01	211.37	229.49	246.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)
Water heating gains (Table 5)													
(72)m=	64.11	62.23	58.32	53.01	49.56	44.71	40.58	45.87	47.75	53.25	59.45	62.24	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	458.67	454.41	436.26	408.66	380.85	356.09	341.84	349.5	365.62	393.41	423.98	446.68	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	491.93	519.46	543.39	564.9	572.33	552.1	528.45	509.8	490.22	470.6	465.44	474.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.9	0.76	0.6	0.64	0.85	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.77	19.88	20.1	20.41	20.7	20.91	20.98	20.97	20.84	20.48	20.08	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.94	0.86	0.67	0.46	0.5	0.77	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.24	18.41	18.73	19.18	19.57	19.81	19.87	19.86	19.74	19.28	18.7	18.21	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.99	19.13	19.4	19.78	20.12	20.35	20.41	20.41	20.28	19.87	19.37	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	18.98	19.25	19.63	19.97	20.2	20.26	20.26	20.13	19.72	19.22	18.82	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.86	0.7	0.51	0.55	0.79	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	485.65	510.22	526.93	529.21	492.17	385.92	269.53	280.85	388.6	442.56	455.7	468.85	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.84	1089.57	984.52	819.16	630.06	422.03	275.99	290.12	456.22	694.26	927.22	1122.91	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	477.79	389.32	340.44	208.77	102.59	0	0	0	0	187.27	339.5	486.62	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2532.3	(98)
Space heating requirement in kWh/m²/year	42.25	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	477.79	389.32	340.44	208.77	102.59	0	0	0	0	187.27	339.5	486.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	511.01	416.39	364.11	223.28	109.73	0	0	0	0	200.28	363.1	520.45		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2708.34	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88		
Efficiency of water heater													87.3	(216)
(217)m=	89.73	89.68	89.57	89.32	88.78	87.3	87.3	87.3	87.3	89.21	89.58	89.75		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	163.91	143.87	149.71	132.41	128.94	114.86	108.11	121.67	122.41	137.59	147.61	159.19		
Total = Sum(219a)$_{1...12}$ =													1630.26	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2708.34	
Water heating fuel used			1630.26	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	94.25	(240)

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Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	56.73	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.12	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	322.99	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		81.97	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	585	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	352.14	(264)
Space and water heating	(261) + (262) + (263) + (264) =			937.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1141.78	(272)
CO2 emissions per m²		(272) ÷ (4) =		19.05	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3304.18	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1988.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5293.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	980.25	(268)
'Total Primary Energy		sum of (265)…(271) =		6503.6	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		108.5	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - Baseline

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22	

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35	
										Total = Sum(44)$_{1…12}$ =		974.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32	
										Total = Sum(45)$_{1…12}$ =		1277.96	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	45.53	39.63	42.22	39.25	38.91	36.05	37.25	38.91	39.25	42.22	42.46	45.53	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85	

Output from water heater (annual)$_{1\ldots12}$ 1765.17 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	55.44	48.44	50.32	44.48	42.99	37.71	35.91	40.25	40.7	46.55	49.9	54.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	74.51	72.08	67.63	61.77	57.78	52.38	48.27	54.1	56.52	62.56	69.31	72.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.09	318.43	306.46	287.81	269.18	251.22	239.98	246.04	255.98	274.81	296.2	312.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	354.34	383.48	413.58	444.05	460.65	447.23	426.59	406.33	380.58	352	337.66	339.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.84	0.69	0.73	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.76	19.99	20.31	20.63	20.87	20.96	20.95	20.77	20.37	19.95	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.92	0.76	0.54	0.6	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.26	18.59	19.07	19.52	19.82	19.91	19.9	19.71	19.16	18.55	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	18.99	19.28	19.68	20.06	20.34	20.43	20.42	20.23	19.75	19.24	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.85	18.99	19.28	19.68	20.06	20.34	20.43	20.42	20.23	19.75	19.24	18.83	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.79	0.61	0.66	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.13	381.37	408.94	431.12	423.91	354.98	262.28	269.78	336.72	344.07	335.62	338.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1076.42	1040.05	940.56	784.14	606.8	411.96	274.72	287.8	442.15	664.23	884.98	1071.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	538.13	442.63	395.53	254.17	136.07	0	0	0	0	238.19	395.54	545.39	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2945.65	(98)
Space heating requirement in kWh/m²/year	49.14	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	538.13	442.63	395.53	254.17	136.07	0	0	0	0	238.19	395.54	545.39		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	576.16	473.91	423.48	272.13	145.69	0	0	0	0	255.03	423.49	583.93		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3153.8	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85		
Efficiency of water heater													80.3	(216)
(217)m=	87.66	87.54	87.22	86.48	85	80.3	80.3	80.3	80.3	86.2	87.23	87.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	203.09	177.65	185.52	165.95	163.46	152.39	146	162.76	164.56	174.55	184.13	198.15		
Total = Sum(219a)$_{1...12}$ =													2078.23	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3153.8	
Water heating fuel used			2078.23	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	681.22	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	448.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1130.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1334.76	(272)

TER =	22.27	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:54

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 59.94m²

Site Reference : Lawnwood House **Plot Reference:** Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	22.27 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.31 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	62.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	57.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.51 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: West	5.54m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Benjamin Leech
Stroma Number: STRO033391
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.25

Property Address: Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) = 20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1\ldots12}$ /12= 76.31 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.51	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.06	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	

Output from water heater (annual)$_{1...12}$ 1448.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.7	41.82	43.39	38.17	36.87	32.19	30.19	34.13	34.38	39.61	42.8	46.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)
Water heating gains (Table 5)													
(72)m=	64.11	62.23	58.32	53.01	49.56	44.71	40.58	45.87	47.75	53.25	59.45	62.24	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	310.69	308.57	297.15	279.05	260.96	243.54	232.3	237.81	247.21	265.5	286.34	301.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.94	373.62	404.28	435.28	452.43	439.55	418.91	398.11	371.8	342.68	327.8	329.04	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.86	0.72	0.76	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.67	19.9	20.24	20.57	20.84	20.95	20.93	20.73	20.31	19.87	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.62	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.09	18.44	18.94	19.41	19.75	19.85	19.85	19.63	19.04	18.4	17.9	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.72	18.87	19.16	19.58	19.98	20.29	20.39	20.38	20.17	19.66	19.12	18.7	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.57	18.72	19.01	19.43	19.83	20.14	20.24	20.23	20.02	19.51	18.97	18.55	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.8	0.62	0.67	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.81	371.66	399.94	423.27	418.23	352.47	260.2	267.36	331.15	335.42	325.92	328.16	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1106.7	1069.04	965.61	803.39	619.11	417.27	274.6	288.15	447.85	678.37	908.14	1102.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	568.34	468.64	420.86	273.69	149.46	0	0	0	0	255.16	419.2	575.94	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3131.27	(98)
Space heating requirement in kWh/m²/year	52.24	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	568.34	468.64	420.86	273.69	149.46	0	0	0	0	255.16	419.2	575.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	607.85	501.22	450.12	292.71	159.85	0	0	0	0	272.9	448.34	615.97		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3348.95	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88		
Efficiency of water heater													87.3	(216)
(217)m=	89.82	89.79	89.71	89.51	89.08	87.3	87.3	87.3	87.3	89.44	89.71	89.85		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	163.73	143.7	149.48	132.12	128.51	114.86	108.11	121.67	122.41	137.23	147.39	159.03		
Total = Sum(219a)$_{1...12}$ =													1628.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3348.95	
Water heating fuel used			1628.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)
Electricity generated by PVs			-466.18	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	723.37	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	351.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1075.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-241.95	(269)
Total CO2, kg/year	sum of (265)…(271) =			1037.77	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.31	(273)
EI rating (section 14)				87	(274)

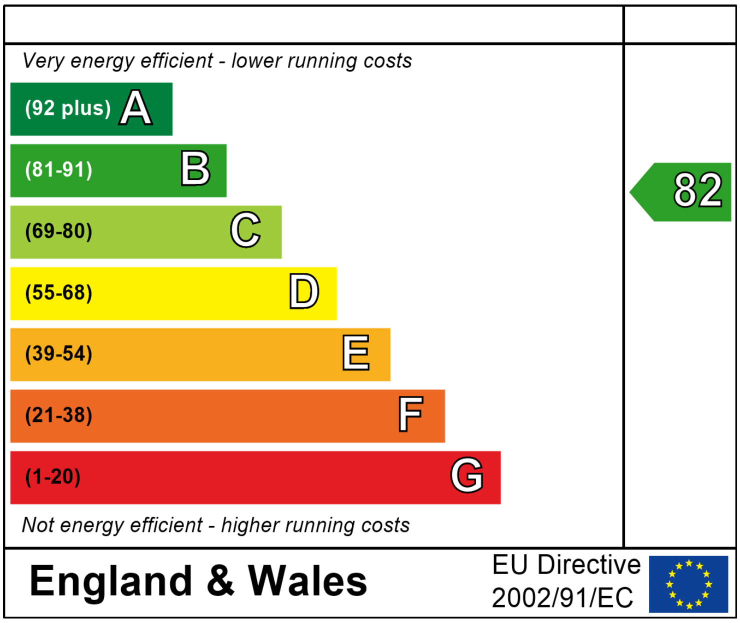
Predicted Energy Assessment

Flat 6	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	59.94 m²
BS5 0EF		

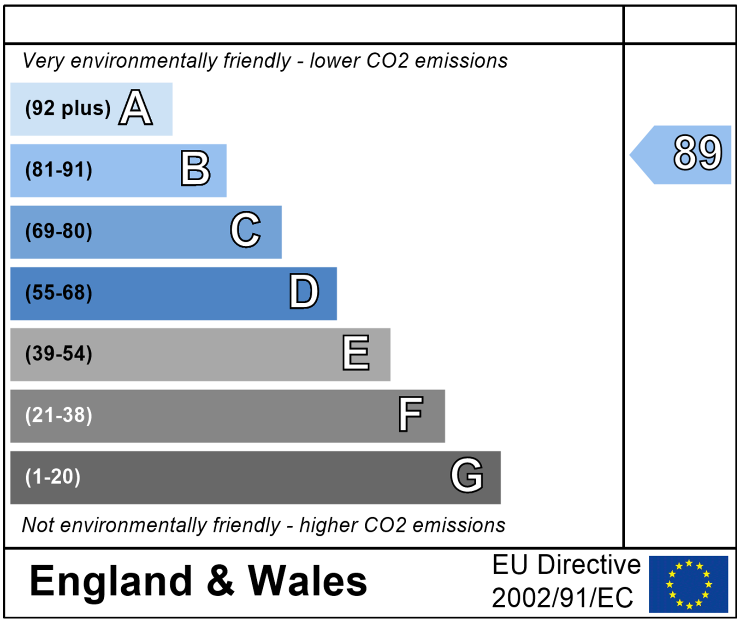
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home’s impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground floor	59.94	(1a) x	2.3	(2a) =	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1\ldots12}$ /12= 76.31 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1...12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1...12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.62	19.86	20.21	20.54	20.82	20.94	20.92	20.7	20.27	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.8	0.59	0.65	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.61	18.85	19.2	19.53	19.78	19.86	19.85	19.68	19.26	18.82	18.47	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.98	19.11	19.35	19.69	20.03	20.29	20.39	20.38	20.18	19.76	19.32	18.97	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.67	0.72	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.04	343.87	374.35	401.76	403.18	348.52	265.64	270.31	319.38	312.83	299.16	299.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1139.06	1099.24	991.65	823.52	634.01	428.95	285.77	299.23	460.38	697.21	934.42	1134.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	613.82	507.61	459.27	303.66	171.74	0	0	0	0	285.98	457.39	621.08	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3420.55 (98)

Space heating requirement in kWh/m²/year 57.07 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	708.52	557.77	571.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.78	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	508.92	451.67	444.75	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	38.91	65.14	51.68	0	0	0	0

Total = Sum(104)$_{6...8}$ = 155.72 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	9.73	16.28	12.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 38.93 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.65 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 57.72 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1…12}$ /12= 72.73 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35

Total = Sum(44)$_{1…12}$ = 974.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32

Total = Sum(45)$_{1…12}$ = 1277.96 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	112.62	98.5	101.64	88.62	85.03	73.37	67.99	78.02	78.95	92.01	100.44	109.07	

Output from water heater (annual)$_{1...12}$ 1086.27 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.16	24.63	25.41	22.15	21.26	18.34	17	19.51	19.74	23	25.11	27.27	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	37.84	36.64	34.15	30.77	28.57	25.48	22.85	26.22	27.41	30.92	34.87	36.65	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	281.42	279.99	269.98	253.81	236.97	221.31	211.56	215.16	223.87	240.17	258.76	273.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	314.67	345.04	377.11	410.05	428.45	417.32	398.17	375.45	348.47	317.36	300.23	300.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.72	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.7	19.93	20.26	20.59	20.85	20.96	20.94	20.74	20.32	19.9	19.56	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.79	0.58	0.64	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.72	18.95	19.29	19.61	19.84	19.91	19.9	19.75	19.35	18.93	18.59	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.08	19.2	19.43	19.77	20.09	20.34	20.42	20.41	20.23	19.83	19.4	19.07	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.82	0.65	0.7	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.07	343.9	374.35	401.49	401.68	343.84	258.75	264.27	317.53	312.74	299.19	299.99	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1093.54	1055.26	952.06	790.49	608.79	411.8	274.48	287.43	442.28	669.41	896.77	1088.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	579.92	478.03	429.81	280.08	154.09	0	0	0	0	265.37	430.26	586.95	(98)

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3204.51 (98)

Space heating requirement in kWh/m²/year 53.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	674.88	531.29	544.57	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.75	0.84	0.81	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	503.95	443.94	438.42	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	562.96	539.22	514.21	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	42.49	70.89	56.39	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 169.77 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.62	17.72	14.1	0	0	0	0

Total = $Sum(107)_{6...8}$ = 42.44 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.71 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 54.17 (109)

Target Fabric Energy Efficiency (TFEE) 62.3 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.94	(1a)	x	2.3	(2a)	=	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.89 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.57	77.38	77.19	76.31	76.14	75.37	75.37	75.23	75.67	76.14	76.48	76.83	

Average = Sum(39)$_{1\ldots12}$ /12= 76.31 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28

Average = Sum(40)$_{1…12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35	
										Total = Sum(44)$_{1…12}$ =		974.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32	
										Total = Sum(45)$_{1…12}$ =		1277.96	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.57	13.14	14.51	14.01	14.45	13.95	14.39	14.43	13.98	14.49	14.06	14.56	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88	

Output from water heater (annual)$_{1...12}$ 1448.5 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.7	41.82	43.39	38.17	36.87	32.19	30.19	34.13	34.38	39.61	42.8	46.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	118.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	45.2	40.15	32.65	24.72	18.48	15.6	16.86	21.91	29.41	37.34	43.58	46.46	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	257.9	260.58	253.84	239.48	221.36	204.32	192.94	190.27	197.01	211.37	229.49	246.52	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	48.86	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	64.11	62.23	58.32	53.01	49.56	44.71	40.58	45.87	47.75	53.25	59.45	62.24	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	458.67	454.41	436.26	408.66	380.85	356.09	341.84	349.5	365.62	393.41	423.98	446.68	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

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West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	491.93	519.46	543.39	564.9	572.33	552.1	528.45	509.8	490.22	470.6	465.44	474.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.9	0.76	0.6	0.64	0.85	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.77	19.88	20.1	20.41	20.7	20.91	20.98	20.97	20.84	20.48	20.08	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.94	0.86	0.67	0.46	0.5	0.77	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.24	18.41	18.73	19.18	19.57	19.81	19.87	19.86	19.74	19.28	18.7	18.21	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.99	19.13	19.4	19.78	20.12	20.35	20.41	20.41	20.28	19.87	19.37	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	18.98	19.25	19.63	19.97	20.2	20.26	20.26	20.13	19.72	19.22	18.82	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.94	0.86	0.7	0.51	0.55	0.79	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	485.65	510.22	526.93	529.21	492.17	385.92	269.53	280.85	388.6	442.56	455.7	468.85	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.84	1089.57	984.52	819.16	630.06	422.03	275.99	290.12	456.22	694.26	927.22	1122.91	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	477.79	389.32	340.44	208.77	102.59	0	0	0	0	187.27	339.5	486.62	(98)

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2532.3	(98)
Space heating requirement in kWh/m²/year	42.25	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	477.79	389.32	340.44	208.77	102.59	0	0	0	0	187.27	339.5	486.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	511.01	416.39	364.11	223.28	109.73	0	0	0	0	200.28	363.1	520.45		(211)
Total (kWh/year) = $Sum(211)_{1...5,10....12}$ =													2708.34	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) = $Sum(215)_{1...5,10....12}$ =													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	147.07	129.02	134.1	118.26	114.48	100.27	94.38	106.22	106.87	122.73	132.23	142.88		
Efficiency of water heater													87.3	(216)
(217)m=	89.73	89.68	89.57	89.32	88.78	87.3	87.3	87.3	87.3	89.21	89.58	89.75		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	163.91	143.87	149.71	132.41	128.94	114.86	108.11	121.67	122.41	137.59	147.61	159.19		
Total = $Sum(219a)_{1...12}$ =													1630.26	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2708.34	
Water heating fuel used			1630.26	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)
Electricity generated by PVs			-466.18	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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Space heating - main system 1	(211) x	3.48	x 0.01 =	94.25	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	56.73	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.12	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	322.99	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		81.97	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	585	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	352.14	(264)
Space and water heating	(261) + (262) + (263) + (264) =			937.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Energy saving/generation technologies Item 1		0.519	=	-241.95	(269)
Total CO2, kg/year		sum of (265)…(271) =		899.83	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.01	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3304.18	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1988.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5293.1	(265)

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Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	980.25	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1431.18	(269)
‘Total Primary Energy			sum of (265)…(271) =		5072.42	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		84.62	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 6 - PV

Address : Flat 6, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.94	(1a) x	2.3	(2a) =	137.86	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	137.86	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			5.54	x1/[1/(1.4)+ 0.04]		=	7.34			(27)
Walls	61.46	7.74	53.72	x	0.18	=	9.67			(29)
Roof	59.94	0	59.94	x	0.13	=	7.79			(30)
Total area of elements, m²			121.4							(31)
Party wall			13.27	x	0	=	0			(32)
Party floor			5994							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.01 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 184179.81 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.69	27.49	27.31	26.42	26.26	25.49	25.49	25.35	25.79	26.26	26.59	26.94	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.8	73.61	72.73	72.56	71.8	71.8	71.65	72.09	72.56	72.9	73.25	

Average = Sum(39)$_{1\ldots12}$ /12= 72.73 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.98 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.22 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.35	86.1	82.85	79.6	76.35	73.1	73.1	76.35	79.6	82.85	86.1	89.35	
										Total = Sum(44)$_{1…12}$ =		974.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	132.5	115.88	119.58	104.25	100.03	86.32	79.99	91.79	92.89	108.25	118.16	128.32	
										Total = Sum(45)$_{1…12}$ =		1277.96	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.87	17.38	17.94	15.64	15.01	12.95	12	13.77	13.93	16.24	17.72	19.25	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	45.53	39.63	42.22	39.25	38.91	36.05	37.25	38.91	39.25	42.22	42.46	45.53	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85	

Output from water heater (annual)$_{1...12}$ 1765.17 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	55.44	48.44	50.32	44.48	42.99	37.71	35.91	40.25	40.7	46.55	49.9	54.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	99	99	99	99	99	99	99	99	99	99	99	99	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.08	16.06	13.06	9.89	7.39	6.24	6.74	8.76	11.76	14.94	17.43	18.58	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.8	174.59	170.07	160.45	148.31	136.9	129.27	127.48	132	141.62	153.76	165.17	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	-79.2	(71)

Water heating gains (Table 5)

(72)m=	74.51	72.08	67.63	61.77	57.78	52.38	48.27	54.1	56.52	62.56	69.31	72.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.09	318.43	306.46	287.81	269.18	251.22	239.98	246.04	255.98	274.81	296.2	312.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
West	0.9x	0.77	x	5.54	x	19.64	x	0.63	x	0.7	=	33.25	(80)
West	0.9x	0.77	x	5.54	x	38.42	x	0.63	x	0.7	=	65.05	(80)
West	0.9x	0.77	x	5.54	x	63.27	x	0.63	x	0.7	=	107.13	(80)
West	0.9x	0.77	x	5.54	x	92.28	x	0.63	x	0.7	=	156.24	(80)
West	0.9x	0.77	x	5.54	x	113.09	x	0.63	x	0.7	=	191.48	(80)

West	0.9x	0.77	x	5.54	x	115.77	x	0.63	x	0.7	=	196.01	(80)
West	0.9x	0.77	x	5.54	x	110.22	x	0.63	x	0.7	=	186.61	(80)
West	0.9x	0.77	x	5.54	x	94.68	x	0.63	x	0.7	=	160.3	(80)
West	0.9x	0.77	x	5.54	x	73.59	x	0.63	x	0.7	=	124.59	(80)
West	0.9x	0.77	x	5.54	x	45.59	x	0.63	x	0.7	=	77.19	(80)
West	0.9x	0.77	x	5.54	x	24.49	x	0.63	x	0.7	=	41.46	(80)
West	0.9x	0.77	x	5.54	x	16.15	x	0.63	x	0.7	=	27.35	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	33.25	65.05	107.13	156.24	191.48	196.01	186.61	160.3	124.59	77.19	41.46	27.35	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	354.34	383.48	413.58	444.05	460.65	447.23	426.59	406.33	380.58	352	337.66	339.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.84	0.69	0.73	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.76	19.99	20.31	20.63	20.87	20.96	20.95	20.77	20.37	19.95	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.92	0.76	0.54	0.6	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.26	18.59	19.07	19.52	19.82	19.91	19.9	19.71	19.16	18.55	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	18.99	19.28	19.68	20.06	20.34	20.43	20.42	20.23	19.75	19.24	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.85	18.99	19.28	19.68	20.06	20.34	20.43	20.42	20.23	19.75	19.24	18.83	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.79	0.61	0.66	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.13	381.37	408.94	431.12	423.91	354.98	262.28	269.78	336.72	344.07	335.62	338.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1076.42	1040.05	940.56	784.14	606.8	411.96	274.72	287.8	442.15	664.23	884.98	1071.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	538.13	442.63	395.53	254.17	136.07	0	0	0	0	238.19	395.54	545.39	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2945.65	(98)
Space heating requirement in kWh/m²/year	49.14	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	538.13	442.63	395.53	254.17	136.07	0	0	0	0	238.19	395.54	545.39		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	576.16	473.91	423.48	272.13	145.69	0	0	0	0	255.03	423.49	583.93		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3153.8	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	178.03	155.51	161.8	143.51	138.94	122.37	117.24	130.7	132.14	150.47	160.62	173.85		
Efficiency of water heater													80.3	(216)
(217)m=	87.66	87.54	87.22	86.48	85	80.3	80.3	80.3	80.3	86.2	87.23	87.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	203.09	177.65	185.52	165.95	163.46	152.39	146	162.76	164.56	174.55	184.13	198.15		
Total = Sum(219a)$_{1...12}$ =													2078.23	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3153.8	
Water heating fuel used			2078.23	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			319.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	681.22	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	448.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1130.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	165.72	(268)
Total CO2, kg/year		sum of (265)…(271) =		1334.76	(272)

TER = 22.27 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:33

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 57.31m²

Site Reference : Lawnwood House **Plot Reference:** Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.28 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	22.67 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C	
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: West	4.16m²
Windows facing: North	6.47m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1...12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1...12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	

Output from water heater (annual)$_{1...12}$ 1977.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.5	82.31	88.3	81.72	81.94	75.89	75.42	79.26	78.02	84.61	86.24	91.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)
Water heating gains (Table 5)													
(72)m=	124.32	122.49	118.68	113.5	110.14	105.4	101.37	106.53	108.36	113.73	119.78	122.5	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	360.07	358.27	347.62	330.55	313.43	296.77	285.83	290.95	299.62	316.87	336.68	351.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	406.06	447.3	496.34	557.54	604.95	602.11	573.62	528.46	475.27	422.66	393.75	389.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	0.61	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.76	20.03	20.4	20.73	20.93	20.98	20.97	20.82	20.41	19.96	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.82	0.61	0.42	0.47	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.22	18.6	19.14	19.57	19.8	19.84	19.83	19.7	19.16	18.51	17.98	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.71	18.89	19.22	19.69	20.08	20.29	20.33	20.33	20.19	19.71	19.14	18.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.71	18.89	19.22	19.69	20.08	20.29	20.33	20.33	20.19	19.71	19.14	18.69		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.47	0.53	0.8	0.95	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	403.08	441.94	483.89	520.9	504.63	393.36	272.06	282.35	380.49	402.99	388.57	387.01		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1096.63	1062.11	964.09	809.39	627.37	422.25	277.31	291.21	453.65	682	904.96	1093.17		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	515.99	416.76	357.27	207.71	91.32	0	0	0	0	207.58	371.8	525.39		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2693.82	(98)
Space heating requirement in kWh/m²/year													47	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	515.99	416.76	357.27	207.71	91.32	0	0	0	0	207.58	371.8	525.39		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	206.48	166.77	142.96	83.12	36.54	0	0	0	0	83.07	148.78	210.24		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1077.96	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	109.28	96.58	102.06	92.36	91.15	82.35	79.95	86.54	86.02	95.73	100.13	106.94		
Total = Sum(219a)$_{1...12}$ =													1129.1	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1077.96

DER WorkSheet: New dwelling design stage

Water heating fuel used			1129.1	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	559.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	586	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1145.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1299.03	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.67	(273)
EI rating (section 14)				83	(274)

Predicted Energy Assessment

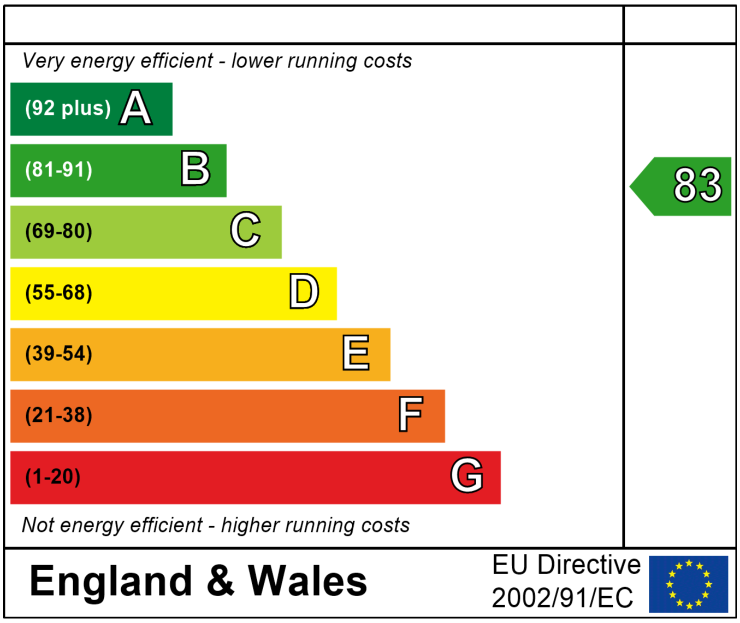
Flat 7
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	57.31 m²

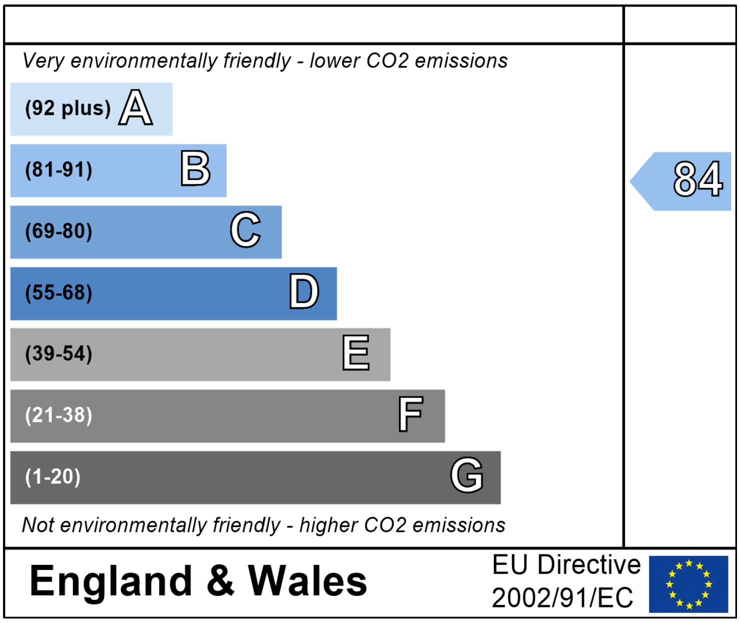
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1...12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1...12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.78	0.63	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.48	19.62	19.9	20.29	20.65	20.89	20.97	20.95	20.75	20.29	19.82	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.55	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.59	18.86	19.25	19.59	19.79	19.84	19.83	19.69	19.26	18.79	18.43	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.73	0.54	0.62	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.95	355.94	403.24	453.4	460.7	376.51	267.73	274.62	341.28	329.18	303.66	299.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1110.57	1073.48	970.73	810.35	625.44	420.9	276.85	290.42	450.76	681.95	912.52	1107.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	591.95	482.19	422.21	257	122.57	0	0	0	0	262.46	438.39	601.46	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3178.22 (98)

Space heating requirement in kWh/m²/year 55.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	698	549.49	563.44	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.81	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	564.14	483.2	473.1	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	81.73	120.13	87.59	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 289.45 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	20.43	30.03	21.9	0	0	0	0

Total = Sum(107)$_{6...8}$ = 72.36 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.26 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.72 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23	

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.59	0.67	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.74	20	20.37	20.71	20.92	20.98	20.97	20.8	20.36	19.92	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.53	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.76	19.02	19.39	19.71	19.88	19.91	19.91	19.79	19.39	18.95	18.6	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.52	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.99	355.98	403.14	452.11	454.71	363.77	254.81	262.84	336.38	328.86	303.69	299.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.77	1009.86	913.37	762.31	588.36	395.58	260.62	273.42	424.52	641.87	858.2	1041.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	542.96	439.41	379.61	223.34	99.44	0	0	0	0	232.88	399.24	552.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2869.02 (98)

Space heating requirement in kWh/m²/year 50.06 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	648.89	510.83	523.73	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.17	464.6	458.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	92.5	133.96	98.66	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 325.12 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	23.12	33.49	24.67	0	0	0	0

Total = Sum(107)$_{6...8}$ = 81.28 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.42 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 51.48 (109)

Target Fabric Energy Efficiency (TFEE) 59.2 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)1…12 /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
									Total = Sum(44)1…12 =			953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
									Total = Sum(45)1…12 =			1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	

Output from water heater (annual)$_{1...12}$ 1977.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.5	82.31	88.3	81.72	81.94	75.89	75.42	79.26	78.02	84.61	86.24	91.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	37.64	33.43	27.19	20.58	15.39	12.99	14.04	18.24	24.49	31.09	36.29	38.69	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	247.93	250.51	244.02	230.22	212.8	196.42	185.48	182.91	189.39	203.2	220.62	236.99	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)
Water heating gains (Table 5)													
(72)m=	124.32	122.49	118.68	113.5	110.14	105.4	101.37	106.53	108.36	113.73	119.78	122.5	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	499.32	495.85	479.32	453.73	427.75	404.24	390.32	397.11	411.67	437.44	466.11	487.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	545.32	584.88	628.04	680.72	719.26	709.58	678.1	634.63	587.32	543.23	523.19	525.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.81	0.63	0.47	0.52	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.84	19.97	20.22	20.55	20.81	20.96	20.99	20.98	20.89	20.57	20.15	19.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.89	0.75	0.53	0.35	0.4	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.32	18.51	18.87	19.33	19.67	19.82	19.84	19.84	19.76	19.37	18.78	18.29	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.14	19.45	19.86	20.16	20.31	20.34	20.34	20.25	19.89	19.38	18.95	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.98	19.14	19.45	19.86	20.16	20.31	20.34	20.34	20.25	19.89	19.38	18.95	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.76	0.57	0.41	0.45	0.71	0.9	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	533.91	567.33	594.87	603.99	549.74	406.88	274.91	287.32	415.02	491.33	505.07	516.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1116.88	1081.57	981.36	822.12	633.92	424.06	277.7	291.87	458.49	695.54	922.9	1113.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	433.73	345.57	287.55	157.05	62.63	0	0	0	0	151.93	300.84	444.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2183.36 (98)

Space heating requirement in kWh/m²/year 38.1 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	433.73	345.57	287.55	157.05	62.63	0	0	0	0	151.93	300.84	444.07	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	173.56	138.28	115.07	62.85	25.06	0	0	0	0	60.8	120.38	177.7	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 873.69 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	109.28	96.58	102.06	92.36	91.15	82.35	79.95	86.54	86.02	95.73	100.13	106.94	

Total = Sum(219a)$_{1...12}$ = 1129.1 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		873.69

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Water heating fuel used			1129.1	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			265.9	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	115.24	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	148.93	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	35.07	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	303.2	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.24	(257)
SAP rating (Section 12)		82.64	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	453.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	586	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1193.02	(272)
CO2 emissions per m²		(272) ÷ (4) =		20.82	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2682.24	(261)

Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	3466.34 (264)
Space and water heating	(261) + (262) + (263) + (264) =			6148.58 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1 (267)
Electricity for lighting	(232) x	0	=	816.31 (268)
'Total Primary Energy	sum of (265)…(271) =			7056.99 (272)
Primary energy kWh/m²/year	(272) ÷ (4) =			123.14 (273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.7 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) — 0.92 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24	

Output from water heater (annual)$_{1...12}$ 1859.1 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.48	75.07	80.28	73.96	73.93	68.13	67.41	71.25	70.27	76.6	78.49	83.12	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	113.55	111.72	107.91	102.73	99.36	94.63	90.6	95.76	97.59	102.95	109.01	111.72	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.29	347.5	336.85	319.78	302.66	286	275.06	280.18	288.85	306.1	325.91	340.56	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	395.29	436.53	485.57	546.77	594.18	591.34	562.85	517.69	464.5	411.89	382.98	378.62	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.86	20.12	20.48	20.78	20.95	20.99	20.98	20.86	20.47	20.04	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.6	0.4	0.46	0.76	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.21	18.41	18.78	19.3	19.69	19.88	19.91	19.91	19.8	19.3	18.68	18.18	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.04	19.36	19.81	20.17	20.34	20.38	20.37	20.26	19.81	19.27	18.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.87	19.04	19.36	19.81	20.17	20.34	20.38	20.37	20.26	19.81	19.27	18.84	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.98	0.93	0.82	0.64	0.46	0.52	0.79	0.95	0.99	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	392.71	431.69	473.75	509.94	490.06	375.61	257.46	267.87	367.65	392.96	378.36	376.59		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1032.34	999.78	907.54	761.47	589.83	396.47	260.88	273.9	426.68	641.76	851.38	1028.47		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	475.88	381.76	322.74	181.1	74.23	0	0	0	0	185.11	340.58	485		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2446.39	(98)
Space heating requirement in kWh/m²/year													42.69	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	475.88	381.76	322.74	181.1	74.23	0	0	0	0	185.11	340.58	485		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	508.96	408.3	345.17	193.69	79.39	0	0	0	0	197.98	364.25	518.72		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2616.46	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24		
Efficiency of water heater													79.8	(216)
(217)m=	87.27	87.05	86.52	85.28	83.06	79.8	79.8	79.8	79.8	85.24	86.7	87.36		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	207.77	183.88	194.98	178.28	180.09	168.54	162.88	177.34	176.59	184.9	191.06	202.87		
Total = Sum(219a)$_{1...12}$ =													2209.17	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2616.46

TER WorkSheet: New dwelling design stage

Water heating fuel used		2209.17	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	565.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	477.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1042.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1219.26	(272)

TER = 31.28 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:23

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 57.31m²

Site Reference : Lawnwood House **Plot Reference:** Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.28 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.16 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services		**OK**
Hot water controls:	Cylinderstat		**OK**
	Independent timer for DHW		**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: West	4.16m²
Windows facing: North	6.47m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32		
										Average = Sum(40)$_{1…12}$ /12=			1.31	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38		
										Total = Sum(44)$_{1…12}$ =			953.22	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49		
										Total = Sum(45)$_{1…12}$ =			1249.83	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	

Output from water heater (annual)$_{1...12}$ 1977.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.5	82.31	88.3	81.72	81.94	75.89	75.42	79.26	78.02	84.61	86.24	91.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	124.32	122.49	118.68	113.5	110.14	105.4	101.37	106.53	108.36	113.73	119.78	122.5	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	360.07	358.27	347.62	330.55	313.43	296.77	285.83	290.95	299.62	316.87	336.68	351.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	406.06	447.3	496.34	557.54	604.95	602.11	573.62	528.46	475.27	422.66	393.75	389.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	0.61	0.85	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.76	20.03	20.4	20.73	20.93	20.98	20.97	20.82	20.41	19.96	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.94	0.82	0.61	0.42	0.47	0.77	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.22	18.6	19.14	19.57	19.8	19.84	19.83	19.7	19.16	18.51	17.98	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.71	18.89	19.22	19.69	20.08	20.29	20.33	20.33	20.19	19.71	19.14	18.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.71	18.89	19.22	19.69	20.08	20.29	20.33	20.33	20.19	19.71	19.14	18.69	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.47	0.53	0.8	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	403.08	441.94	483.89	520.9	504.63	393.36	272.06	282.35	380.49	402.99	388.57	387.01	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1096.63	1062.11	964.09	809.39	627.37	422.25	277.31	291.21	453.65	682	904.96	1093.17	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	515.99	416.76	357.27	207.71	91.32	0	0	0	0	207.58	371.8	525.39	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2693.82 (98)

Space heating requirement in kWh/m²/year 47 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	515.99	416.76	357.27	207.71	91.32	0	0	0	0	207.58	371.8	525.39	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	206.48	166.77	142.96	83.12	36.54	0	0	0	0	83.07	148.78	210.24	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1077.96 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	109.28	96.58	102.06	92.36	91.15	82.35	79.95	86.54	86.02	95.73	100.13	106.94	

Total = Sum(219a)$_{1...12}$ = 1129.1 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1077.96

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Water heating fuel used		1129.1	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		265.9	(232)
Electricity generated by PVs		-607.63	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	559.46	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	586	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1145.46	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	138	(268)
Energy saving/generation technologies Item 1			0.519	=	-315.36	(269)
Total CO2, kg/year			sum of (265)…(271) =		983.67	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.16	(273)
EI rating (section 14)					87	(274)

Predicted Energy Assessment

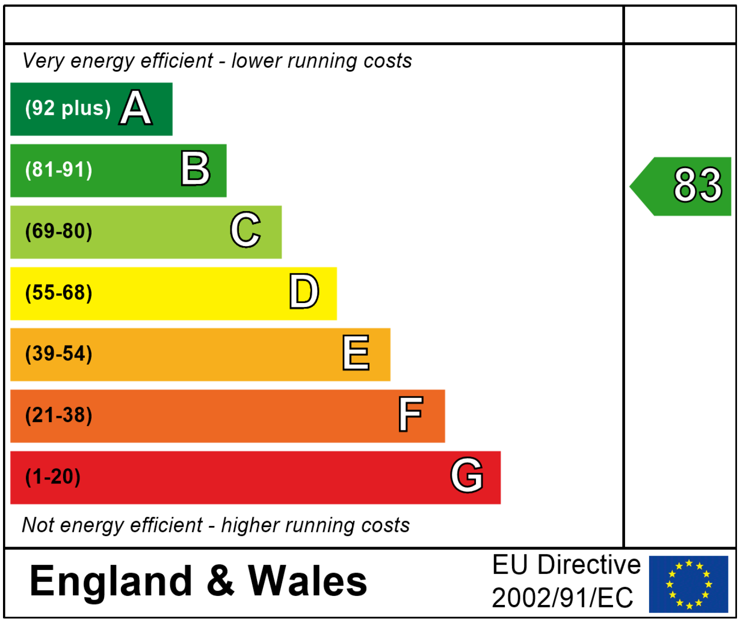
Flat 7
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	57.31 m²

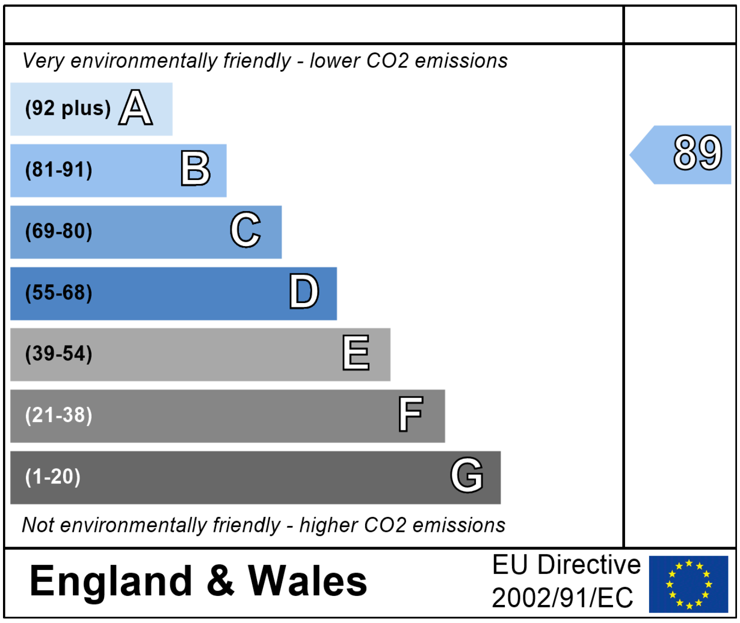
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1…12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.78	0.63	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.48	19.62	19.9	20.29	20.65	20.89	20.97	20.95	20.75	20.29	19.82	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.55	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.59	18.86	19.25	19.59	19.79	19.84	19.83	19.69	19.26	18.79	18.43	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.73	0.54	0.62	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.95	355.94	403.24	453.4	460.7	376.51	267.73	274.62	341.28	329.18	303.66	299.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1110.57	1073.48	970.73	810.35	625.44	420.9	276.85	290.42	450.76	681.95	912.52	1107.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	591.95	482.19	422.21	257	122.57	0	0	0	0	262.46	438.39	601.46	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3178.22 (98)

Space heating requirement in kWh/m²/year 55.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	698	549.49	563.44	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.81	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	564.14	483.2	473.1	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	81.73	120.13	87.59	0	0	0	0

Total = Sum(104)6...8 = 289.45 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)6...8 = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	20.43	30.03	21.9	0	0	0	0

Total = Sum(107)6...8 = 72.36 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.26 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 56.72 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.59	0.67	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.74	20	20.37	20.71	20.92	20.98	20.97	20.8	20.36	19.92	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.53	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.76	19.02	19.39	19.71	19.88	19.91	19.91	19.79	19.39	18.95	18.6	(90)

fLA = Living area ÷ (4) = | 0.43 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.52	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.99	355.98	403.14	452.11	454.71	363.77	254.81	262.84	336.38	328.86	303.69	299.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.77	1009.86	913.37	762.31	588.36	395.58	260.62	273.42	424.52	641.87	858.2	1041.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	542.96	439.41	379.61	223.34	99.44	0	0	0	0	232.88	399.24	552.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2869.02	(98)
Space heating requirement in kWh/m²/year	50.06	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	648.89	510.83	523.73	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.17	464.6	458.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	92.5	133.96	98.66	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	325.12	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

	Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	23.12	33.49	24.67	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	81.28	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.42	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	51.48	(109)
Target Fabric Energy Efficiency (TFEE)		59.2	(109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1…12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
											Total = Sum(44)$_{1…12}$ =	953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
											Total = Sum(45)$_{1…12}$ =	1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	

Output from water heater (annual)$_{1...12}$ 1977.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.5	82.31	88.3	81.72	81.94	75.89	75.42	79.26	78.02	84.61	86.24	91.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.64	33.43	27.19	20.58	15.39	12.99	14.04	18.24	24.49	31.09	36.29	38.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	247.93	250.51	244.02	230.22	212.8	196.42	185.48	182.91	189.39	203.2	220.62	236.99	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	124.32	122.49	118.68	113.5	110.14	105.4	101.37	106.53	108.36	113.73	119.78	122.5	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	499.32	495.85	479.32	453.73	427.75	404.24	390.32	397.11	411.67	437.44	466.11	487.6	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	545.32	584.88	628.04	680.72	719.26	709.58	678.1	634.63	587.32	543.23	523.19	525.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.81	0.63	0.47	0.52	0.76	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.84	19.97	20.22	20.55	20.81	20.96	20.99	20.98	20.89	20.57	20.15	19.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.95	0.89	0.75	0.53	0.35	0.4	0.67	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.32	18.51	18.87	19.33	19.67	19.82	19.84	19.84	19.76	19.37	18.78	18.29	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.98	19.14	19.45	19.86	20.16	20.31	20.34	20.34	20.25	19.89	19.38	18.95	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.98	19.14	19.45	19.86	20.16	20.31	20.34	20.34	20.25	19.89	19.38	18.95	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.76	0.57	0.41	0.45	0.71	0.9	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	533.91	567.33	594.87	603.99	549.74	406.88	274.91	287.32	415.02	491.33	505.07	516.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1116.88	1081.57	981.36	822.12	633.92	424.06	277.7	291.87	458.49	695.54	922.9	1113.01	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	433.73	345.57	287.55	157.05	62.63	0	0	0	0	151.93	300.84	444.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2183.36 (98)

Space heating requirement in kWh/m²/year 38.1 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	433.73	345.57	287.55	157.05	62.63	0	0	0	0	151.93	300.84	444.07	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	173.56	138.28	115.07	62.85	25.06	0	0	0	0	60.8	120.38	177.7	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 873.69 (211)

Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	191.34	169.12	178.71	161.73	159.6	144.19	139.99	151.53	150.61	167.63	175.33	187.26	
Efficiency of water heater												175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	109.28	96.58	102.06	92.36	91.15	82.35	79.95	86.54	86.02	95.73	100.13	106.94	

Total = Sum(219a)$_{1...12}$ = 1129.1 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		873.69

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Water heating fuel used			1129.1	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			265.9	(232)
Electricity generated by PVs			-607.63	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	115.24	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	148.93	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	35.07	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	303.2	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.24	(257)
SAP rating (Section 12)		82.64	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	453.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	586	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Energy saving/generation technologies Item 1		0.519	=	-315.36	(269)
Total CO2, kg/year	sum of (265)…(271) =			877.66	(272)

CO2 emissions per m²		(272) ÷ (4) =		15.31	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2682.24	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3466.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6148.58	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	816.31	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1865.44	(269)
‘Total Primary Energy		sum of (265)…(271) =		5191.55	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		90.59	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - ASHP + PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
									Total = Sum(44)$_{1…12}$ =			953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
									Total = Sum(45)$_{1…12}$ =			1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24	

Output from water heater (annual)$_{1...12}$ 1859.1 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.48	75.07	80.28	73.96	73.93	68.13	67.41	71.25	70.27	76.6	78.49	83.12	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	113.55	111.72	107.91	102.73	99.36	94.63	90.6	95.76	97.59	102.95	109.01	111.72	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.29	347.5	336.85	319.78	302.66	286	275.06	280.18	288.85	306.1	325.91	340.56	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	395.29	436.53	485.57	546.77	594.18	591.34	562.85	517.69	464.5	411.89	382.98	378.62	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.86	0.69	0.53	0.59	0.84	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.73	19.86	20.12	20.48	20.78	20.95	20.99	20.98	20.86	20.47	20.04	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.81	0.6	0.4	0.46	0.76	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.21	18.41	18.78	19.3	19.69	19.88	19.91	19.91	19.8	19.3	18.68	18.18	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.04	19.36	19.81	20.17	20.34	20.38	20.37	20.26	19.81	19.27	18.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.87	19.04	19.36	19.81	20.17	20.34	20.38	20.37	20.26	19.81	19.27	18.84	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.93	0.82	0.64	0.46	0.52	0.79	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	392.71	431.69	473.75	509.94	490.06	375.61	257.46	267.87	367.65	392.96	378.36	376.59	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1032.34	999.78	907.54	761.47	589.83	396.47	260.88	273.9	426.68	641.76	851.38	1028.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	475.88	381.76	322.74	181.1	74.23	0	0	0	0	185.11	340.58	485	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2446.39 (98)

Space heating requirement in kWh/m²/year 42.69 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	475.88	381.76	322.74	181.1	74.23	0	0	0	0	185.11	340.58	485	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	508.96	408.3	345.17	193.69	79.39	0	0	0	0	197.98	364.25	518.72	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2616.46 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)														
	181.33	160.07	168.69	152.04	149.58	134.5	129.98	141.52	140.92	157.61	165.64	177.24		
Efficiency of water heater													79.8	(216)
(217)m=	87.27	87.05	86.52	85.28	83.06	79.8	79.8	79.8	79.8	85.24	86.7	87.36		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	207.77	183.88	194.98	178.28	180.09	168.54	162.88	177.34	176.59	184.9	191.06	202.87		

Total = Sum(219a)$_{1...12}$ = 2209.17 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2616.46

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Water heating fuel used			2209.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	565.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	477.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1042.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1219.26	(272)

TER = 31.28 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:43

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 57.31m²

Site Reference : Lawnwood House **Plot Reference:** Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.35 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.16 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: West	4.16m²
Windows facing: North	6.47m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1\ldots12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1\ldots12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1\ldots12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.56	13.13	14.5	14	14.44	13.94	14.38	14.42	13.97	14.47	14.05	14.55	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04

Output from water heater (annual)$_{1...12}$ 1420.23 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.72	40.96	42.51	37.4	36.14	31.55	29.61	33.45	33.7	38.82	41.94	45.36	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	62.8	60.96	57.14	51.94	48.57	43.83	39.79	44.96	46.8	52.18	58.25	60.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	298.54	296.74	286.08	269	251.87	235.2	224.25	229.38	238.06	255.32	275.15	289.8	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	344.54	385.77	434.8	495.99	543.39	540.54	512.04	466.9	413.71	361.11	332.22	327.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.76	0.61	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.67	19.94	20.32	20.67	20.9	20.97	20.96	20.77	20.32	19.86	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.86	0.67	0.46	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.87	18.08	18.47	19.03	19.51	19.78	19.83	19.83	19.65	19.04	18.37	17.84	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.59	18.77	19.11	19.59	20.01	20.26	20.33	20.32	20.14	19.6	19.02	18.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.44	18.62	18.96	19.44	19.86	20.11	20.18	20.17	19.99	19.45	18.87	18.41		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	0.99	0.98	0.95	0.86	0.69	0.51	0.57	0.84	0.97	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	343.12	382.96	427.54	471.88	469.68	374.05	259.21	268.04	348.83	350.32	329.75	326.78		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1076	1041.65	944.04	790.74	611.45	409.47	265.75	279.38	438.46	662.76	884.7	1072.67		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	545.26	442.64	384.28	229.58	105.48	0	0	0	0	232.45	399.57	554.94		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													2894.2	(98)
Space heating requirement in kWh/m²/year													50.5	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	545.26	442.64	384.28	229.58	105.48	0	0	0	0	232.45	399.57	554.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	602.5	489.11	424.61	253.68	116.55	0	0	0	0	256.86	441.51	613.19		
Total (kWh/year) =Sum(211)1...5,10...12=													3198.01	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04		
Efficiency of water heater													87.3	(216)
(217)m=	89.81	89.77	89.66	89.4	88.82	87.3	87.3	87.3	87.3	89.38	89.69	89.84		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	160.49	140.87	146.61	129.7	126.4	112.67	106.09	119.34	120.06	134.64	144.5	155.88		
Total = Sum(219a)1...12 =													1597.24	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3198.01

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Water heating fuel used			1597.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	690.77	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	345	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1035.77	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	138	(268)
Total CO2, kg/year			sum of (265)…(271) =		1212.7	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		21.16	(273)
EI rating (section 14)					84	(274)

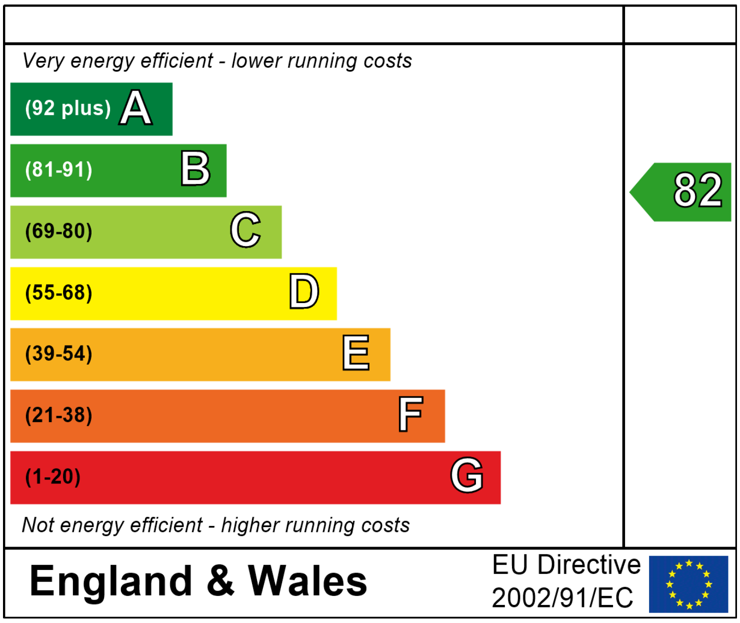
Predicted Energy Assessment

Flat 7	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	57.31 m²
BS5 0EF		

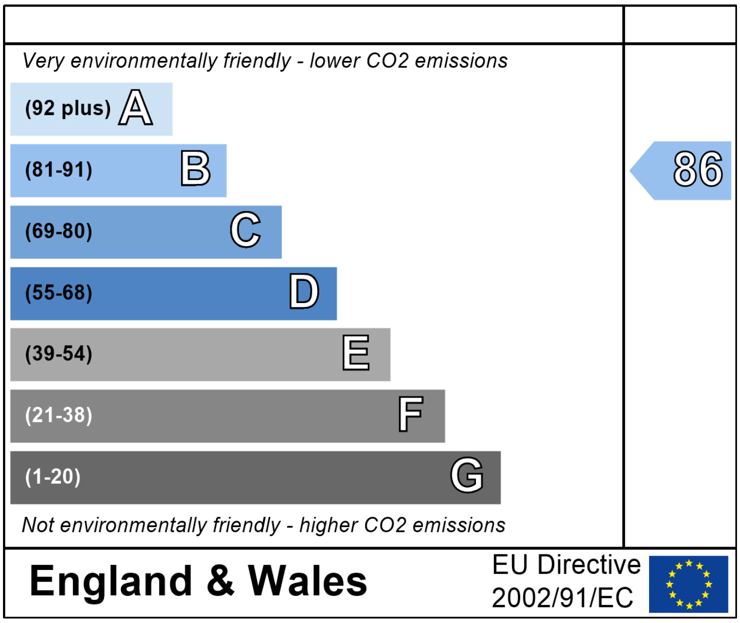
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1...12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1...12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1…12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.78	0.63	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.48	19.62	19.9	20.29	20.65	20.89	20.97	20.95	20.75	20.29	19.82	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.55	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.59	18.86	19.25	19.59	19.79	19.84	19.83	19.69	19.26	18.79	18.43	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.73	0.54	0.62	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.95	355.94	403.24	453.4	460.7	376.51	267.73	274.62	341.28	329.18	303.66	299.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1110.57	1073.48	970.73	810.35	625.44	420.9	276.85	290.42	450.76	681.95	912.52	1107.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	591.95	482.19	422.21	257	122.57	0	0	0	0	262.46	438.39	601.46	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3178.22 (98)

Space heating requirement in kWh/m²/year 55.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	698	549.49	563.44	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.81	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	564.14	483.2	473.1	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	81.73	120.13	87.59	0	0	0	0

Total = Sum(104)$_{6...8}$ = 289.45 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	20.43	30.03	21.9	0	0	0	0

Total = Sum(107)$_{6...8}$ = 72.36 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.26 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.72 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.31	(1a) x	2.3	(2a) =	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0 | (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) — (26)…(30) + (32) = | 29.13 | (33)

Heat capacity Cm = S(A x k) — ((28)…(30) + (32) + (32a)…(32e) = | 5353.14 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K — Indicative Value: Medium | 250 | (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 15.87 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss — (33) + (36) = | 44.99 | (37)

Ventilation heat loss calculated monthly — (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= | 69.81 | (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23	

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.59	0.67	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.74	20	20.37	20.71	20.92	20.98	20.97	20.8	20.36	19.92	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.53	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.76	19.02	19.39	19.71	19.88	19.91	19.91	19.79	19.39	18.95	18.6	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.52	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.99	355.98	403.14	452.11	454.71	363.77	254.81	262.84	336.38	328.86	303.69	299.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.77	1009.86	913.37	762.31	588.36	395.58	260.62	273.42	424.52	641.87	858.2	1041.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	542.96	439.41	379.61	223.34	99.44	0	0	0	0	232.88	399.24	552.14	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2869.02 (98)

Space heating requirement in kWh/m²/year 50.06 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	648.89	510.83	523.73	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.17	464.6	458.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	92.5	133.96	98.66	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 325.12 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	23.12	33.49	24.67	0	0	0	0

Total = $Sum(107)_{6...8}$ = 81.28 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.42 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 51.48 (109)

Target Fabric Energy Efficiency (TFEE) 59.2 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1\ldots12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
										Total = Sum(44)$_{1\ldots12}$ =		953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
										Total = Sum(45)$_{1\ldots12}$ =		1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.56	13.13	14.5	14	14.44	13.94	14.38	14.42	13.97	14.47	14.05	14.55	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	

Output from water heater (annual)$_{1...12}$ 1420.23 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.72	40.96	42.51	37.4	36.14	31.55	29.61	33.45	33.7	38.82	41.94	45.36	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.64	33.43	27.19	20.58	15.39	12.99	14.04	18.24	24.49	31.09	36.29	38.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	247.93	250.51	244.02	230.22	212.8	196.42	185.48	182.91	189.39	203.2	220.62	236.99	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	62.8	60.96	57.14	51.94	48.57	43.83	39.79	44.96	46.8	52.18	58.25	60.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	437.8	434.32	417.78	392.17	366.18	342.66	328.74	335.54	350.11	375.89	404.58	426.08	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.8	523.35	566.49	619.17	657.7	648.01	616.52	573.06	525.76	481.68	461.65	464.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.84	0.68	0.52	0.57	0.81	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	19.88	20.13	20.48	20.77	20.94	20.99	20.98	20.86	20.49	20.06	19.72	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.91	0.79	0.58	0.39	0.44	0.73	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.38	18.75	19.24	19.62	19.81	19.84	19.84	19.73	19.27	18.66	18.15	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.86	19.03	19.35	19.78	20.12	20.3	20.34	20.33	20.22	19.8	19.27	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.71	18.88	19.2	19.63	19.97	20.15	20.19	20.18	20.07	19.65	19.12	18.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.79	0.6	0.43	0.48	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.84	512.07	543.8	562.41	522.35	391.45	263.07	274.9	392.14	446.91	450.59	458.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1096.65	1061.65	962.18	804.86	619.48	412.02	266.36	280.43	444.99	677.77	903.29	1092.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	461.13	369.32	311.27	174.56	72.26	0	0	0	0	171.77	325.94	471.95	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2358.21 (98)

Space heating requirement in kWh/m²/year 41.15 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	461.13	369.32	311.27	174.56	72.26	0	0	0	0	171.77	325.94	471.95	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	509.54	408.08	343.95	192.89	79.85	0	0	0	0	189.8	360.16	521.49	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2605.75 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)														
	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04		
Efficiency of water heater													87.3	(216)
(217)m=	89.72	89.66	89.53	89.2	88.53	87.3	87.3	87.3	87.3	89.15	89.57	89.75		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	160.66	141.04	146.83	130	126.82	112.67	106.09	119.34	120.06	134.98	144.71	156.04		

Total = Sum(219a)$_{1...12}$ = 1599.23 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2605.75

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Water heating fuel used		1599.23	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		265.9	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	90.68	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	55.65	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	35.07	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	311.3	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.17	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	562.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	345.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =			908.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1085.2	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.94	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3179.02	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1951.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5130.08	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	816.31	(268)
'Total Primary Energy			sum of (265)…(271) =		6176.64	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		107.78	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - Baseline

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23		

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	44.53	38.76	41.29	38.39	38.05	35.26	36.43	38.05	38.39	41.29	41.52	44.53	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02	

Output from water heater (annual)$_{1...12}$ 1726.31 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	54.22	47.37	49.21	43.5	42.04	36.88	35.12	39.36	39.8	45.52	48.81	52.86	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	72.87	70.49	66.14	60.41	56.51	51.23	47.2	52.9	55.28	61.19	67.78	71.05	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	308.61	306.28	295.08	277.47	259.81	242.6	231.66	237.32	246.54	264.33	284.69	299.88	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	354.61	395.3	443.8	504.46	551.32	547.94	519.45	474.84	422.19	370.12	341.76	337.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.89	0.73	0.57	0.63	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.66	19.8	20.06	20.42	20.74	20.93	20.98	20.97	20.82	20.41	19.98	19.64	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.63	0.44	0.5	0.81	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.12	18.32	18.69	19.22	19.65	19.87	19.91	19.91	19.77	19.22	18.59	18.09	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	18.96	19.29	19.74	20.13	20.33	20.38	20.37	20.23	19.74	19.19	18.76	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.79	18.96	19.29	19.74	20.13	20.33	20.38	20.37	20.23	19.74	19.19	18.76	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.56	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.11	392.31	435.97	477.94	470.14	368.93	256	265.24	350.68	358.2	339.1	336.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1026.57	994.04	902	756.81	587.06	395.62	260.69	273.56	424.39	636.72	845.7	1022.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	501.06	404.36	346.73	200.79	86.99	0	0	0	0	207.22	364.76	510.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2622.23 (98)

Space heating requirement in kWh/m²/year 45.76 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	501.06	404.36	346.73	200.79	86.99	0	0	0	0	207.22	364.76	510.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	536.47	432.94	371.23	214.98	93.13	0	0	0	0	221.86	390.53	546.4	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2807.53 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02	
Efficiency of water heater												80.3	(216)
(217)m=	87.56	87.4	86.97	85.95	83.96	80.3	80.3	80.3	80.3	85.91	87.1	87.65	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	198.84	174.02	181.94	163.29	161.84	149.04	142.79	159.18	160.93	171.28	180.35	193.99	

Total = Sum(219a)$_{1...12}$ = 2037.49 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2807.53

TER WorkSheet: New dwelling design stage

Water heating fuel used			2037.49	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	606.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	440.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1046.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1223.45	(272)

TER =	21.35	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:13

Project Information:

Assessed By:	Benjamin Leech (STRO033391)	**Building Type:**	Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE		Total Floor Area: 57.31m²	
Site Reference :	Lawnwood House	**Plot Reference:**	Flat 7 - PV
Address :	Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF		

Client Details:

Name:
Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	21.35 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.12 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.7 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder		

6 Controls

Space heating controls	TTZC by plumbing and electrical services		OK
Hot water controls:	No cylinder thermostat		
	No cylinder		
Boiler interlock:	Yes		OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: West	4.16m²
Windows facing: North	6.47m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1…12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
										Total = Sum(44)$_{1…12}$ =		953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
										Total = Sum(45)$_{1…12}$ =		1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.56	13.13	14.5	14	14.44	13.94	14.38	14.42	13.97	14.47	14.05	14.55	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	

Output from water heater (annual)$_{1...12}$ 1420.23 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.72	40.96	42.51	37.4	36.14	31.55	29.61	33.45	33.7	38.82	41.94	45.36	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	62.8	60.96	57.14	51.94	48.57	43.83	39.79	44.96	46.8	52.18	58.25	60.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	298.54	296.74	286.08	269	251.87	235.2	224.25	229.38	238.06	255.32	275.15	289.8	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	344.54	385.77	434.8	495.99	543.39	540.54	512.04	466.9	413.71	361.11	332.22	327.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.76	0.61	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.67	19.94	20.32	20.67	20.9	20.97	20.96	20.77	20.32	19.86	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.86	0.67	0.46	0.53	0.83	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.87	18.08	18.47	19.03	19.51	19.78	19.83	19.83	19.65	19.04	18.37	17.84	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.59	18.77	19.11	19.59	20.01	20.26	20.33	20.32	20.14	19.6	19.02	18.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.44	18.62	18.96	19.44	19.86	20.11	20.18	20.17	19.99	19.45	18.87	18.41	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.69	0.51	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	343.12	382.96	427.54	471.88	469.68	374.05	259.21	268.04	348.83	350.32	329.75	326.78	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1076	1041.65	944.04	790.74	611.45	409.47	265.75	279.38	438.46	662.76	884.7	1072.67	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	545.26	442.64	384.28	229.58	105.48	0	0	0	0	232.45	399.57	554.94	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2894.2 (98)

Space heating requirement in kWh/m²/year 50.5 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	545.26	442.64	384.28	229.58	105.48	0	0	0	0	232.45	399.57	554.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	602.5	489.11	424.61	253.68	116.55	0	0	0	0	256.86	441.51	613.19		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3198.01	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04		
Efficiency of water heater													87.3	(216)
(217)m=	89.81	89.77	89.66	89.4	88.82	87.3	87.3	87.3	87.3	89.38	89.69	89.84		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	160.49	140.87	146.61	129.7	126.4	112.67	106.09	119.34	120.06	134.64	144.5	155.88		
Total = Sum(219a)$_{1...12}$ =													1597.24	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3198.01

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Water heating fuel used			1597.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			265.9	(232)
Electricity generated by PVs			-445.65	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	690.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	345	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1035.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Energy saving/generation technologies Item 1		0.519	=	-231.29	(269)
Total CO2, kg/year		sum of (265)…(271) =		981.41	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.12	(273)
EI rating (section 14)				87	(274)

Predicted Energy Assessment

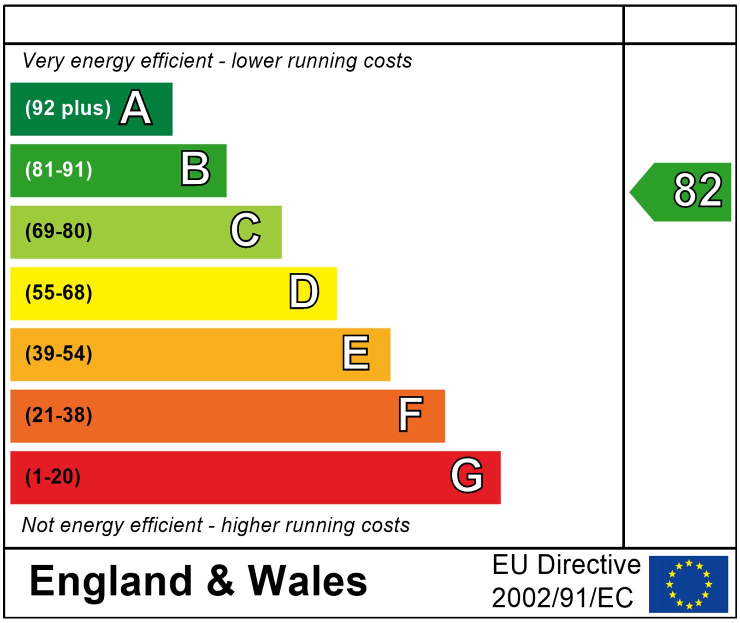
Flat 7
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	57.31 m²

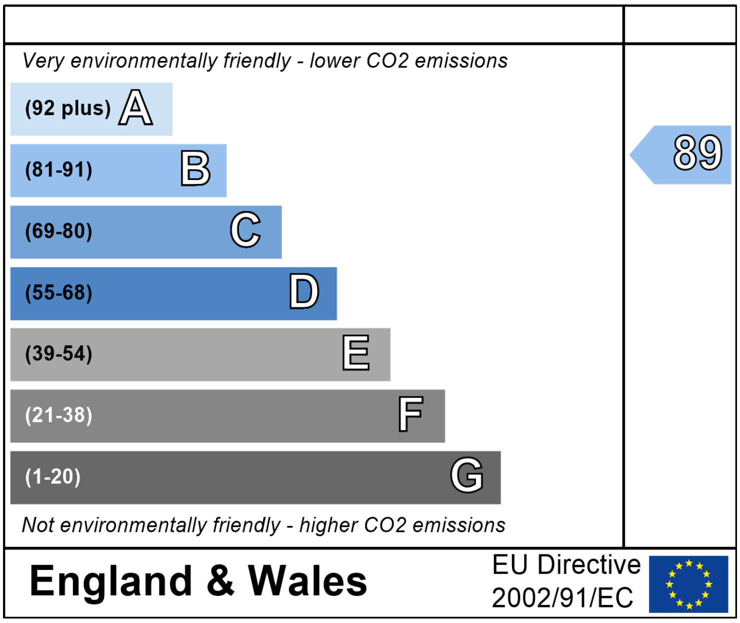
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = $Sum(39)_{1…12}$ /12= 75.03 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = Sum(40)$_{1…12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)
Water heating gains (Table 5)													
(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.78	0.63	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.48	19.62	19.9	20.29	20.65	20.89	20.97	20.95	20.75	20.29	19.82	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.55	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.59	18.86	19.25	19.59	19.79	19.84	19.83	19.69	19.26	18.79	18.43	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.9	19.04	19.31	19.7	20.05	20.27	20.33	20.32	20.15	19.71	19.24	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.89	0.73	0.54	0.62	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.95	355.94	403.24	453.4	460.7	376.51	267.73	274.62	341.28	329.18	303.66	299.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1110.57	1073.48	970.73	810.35	625.44	420.9	276.85	290.42	450.76	681.95	912.52	1107.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	591.95	482.19	422.21	257	122.57	0	0	0	0	262.46	438.39	601.46	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3178.22 (98)

Space heating requirement in kWh/m²/year 55.46 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	698	549.49	563.44	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.81	0.88	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	564.14	483.2	473.1	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	81.73	120.13	87.59	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 289.45 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	20.43	30.03	21.9	0	0	0	0

Total = $Sum(107)_{6...8}$ = 72.36 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.26 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 56.72 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40	=	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20	=	0	(6b)
Number of intermittent fans							2	x 10	=	20	(7a)
Number of passive vents							0	x 10	=	0	(7b)
Number of flueless gas fires							0	x 40	=	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = $Sum(39)_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23

Average = Sum(40)$_{1…12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1…12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1…12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	110.14	96.33	99.41	86.66	83.16	71.76	66.49	76.3	77.21	89.99	98.23	106.67	

Output from water heater (annual)$_{1...12}$ 1062.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.54	24.08	24.85	21.67	20.79	17.94	16.62	19.08	19.3	22.5	24.56	26.67	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	37.01	35.84	33.4	30.09	27.94	24.92	22.34	25.64	26.81	30.24	34.11	35.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	269.75	268.62	259.34	244.14	228.24	213.29	203.8	207.06	215.07	230.39	248.01	261.67	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	315.75	357.65	408.06	471.13	519.76	518.63	491.59	444.57	390.72	336.18	305.08	299.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.59	0.67	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.74	20	20.37	20.71	20.92	20.98	20.97	20.8	20.36	19.92	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.53	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.76	19.02	19.39	19.71	19.88	19.91	19.91	19.79	19.39	18.95	18.6	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.04	19.18	19.45	19.82	20.14	20.33	20.38	20.37	20.23	19.81	19.37	19.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.87	0.7	0.52	0.59	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	314.99	355.98	403.14	452.11	454.71	363.77	254.81	262.84	336.38	328.86	303.69	299.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1044.77	1009.86	913.37	762.31	588.36	395.58	260.62	273.42	424.52	641.87	858.2	1041.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	542.96	439.41	379.61	223.34	99.44	0	0	0	0	232.88	399.24	552.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2869.02 (98)

Space heating requirement in kWh/m²/year 50.06 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	648.89	510.83	523.73	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	549.17	464.6	458.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	677.65	644.66	590.84	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	92.5	133.96	98.66	0	0	0	0

Total = Sum(104)$_{6..8}$ = 325.12 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	23.12	33.49	24.67	0	0	0	0

Total = Sum(107)$_{6..8}$ = 81.28 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.42 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 51.48 (109)

Target Fabric Energy Efficiency (TFEE) 59.2 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 50.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.09	75.93	75.77	75.04	74.9	74.26	74.26	74.14	74.5	74.9	75.18	75.47	

Average = Sum(39)$_{1…12}$ /12= 75.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.32	1.32	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.31	1.32

Average = $Sum(40)_{1…12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38	
										Total = $Sum(44)_{1…12}$ =		953.22	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49	
										Total = $Sum(45)_{1…12}$ =		1249.83	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.56	13.13	14.5	14	14.44	13.94	14.38	14.42	13.97	14.47	14.05	14.55	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	

Output from water heater (annual)$_{1...12}$ 1420.23 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.72	40.96	42.51	37.4	36.14	31.55	29.61	33.45	33.7	38.82	41.94	45.36	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	114.28	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.64	33.43	27.19	20.58	15.39	12.99	14.04	18.24	24.49	31.09	36.29	38.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	247.93	250.51	244.02	230.22	212.8	196.42	185.48	182.91	189.39	203.2	220.62	236.99	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	48.33	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	62.8	60.96	57.14	51.94	48.57	43.83	39.79	44.96	46.8	52.18	58.25	60.97	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	437.8	434.32	417.78	392.17	366.18	342.66	328.74	335.54	350.11	375.89	404.58	426.08	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.8	523.35	566.49	619.17	657.7	648.01	616.52	573.06	525.76	481.68	461.65	464.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.84	0.68	0.52	0.57	0.81	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	19.88	20.13	20.48	20.77	20.94	20.99	20.98	20.86	20.49	20.06	19.72	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.84	19.84	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.91	0.79	0.58	0.39	0.44	0.73	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.38	18.75	19.24	19.62	19.81	19.84	19.84	19.73	19.27	18.66	18.15	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.86	19.03	19.35	19.78	20.12	20.3	20.34	20.33	20.22	19.8	19.27	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.71	18.88	19.2	19.63	19.97	20.15	20.19	20.18	20.07	19.65	19.12	18.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.79	0.6	0.43	0.48	0.75	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.84	512.07	543.8	562.41	522.35	391.45	263.07	274.9	392.14	446.91	450.59	458.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1096.65	1061.65	962.18	804.86	619.48	412.02	266.36	280.43	444.99	677.77	903.29	1092.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	461.13	369.32	311.27	174.56	72.26	0	0	0	0	171.77	325.94	471.95	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2358.21 (98)

Space heating requirement in kWh/m²/year 41.15 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	461.13	369.32	311.27	174.56	72.26	0	0	0	0	171.77	325.94	471.95	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	509.54	408.08	343.95	192.89	79.85	0	0	0	0	189.8	360.16	521.49	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 2605.75 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	144.14	126.46	131.45	115.95	112.27	98.36	92.61	104.19	104.81	120.34	129.61	140.04	
Efficiency of water heater												87.3	(216)
(217)m=	89.72	89.66	89.53	89.2	88.53	87.3	87.3	87.3	87.3	89.15	89.57	89.75	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	160.66	141.04	146.83	130	126.82	112.67	106.09	119.34	120.06	134.98	144.71	156.04	

Total = $Sum(219a)_{1...12}$ = 1599.23 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2605.75

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Water heating fuel used				1599.23	
Electricity for pumps, fans and electric keep-hot					
central heating pump:		30			(230c)
boiler with a fan-assisted flue		45			(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =			75	(231)
Electricity for lighting				265.9	(232)
Electricity generated by PVs				-445.65	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	90.68	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	55.65	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	35.07	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	311.3	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.17	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	562.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	345.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =			908.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-231.29	(269)

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Total CO2, kg/year	sum of (265)…(271) =	853.91	(272)
CO2 emissions per m²	(272) ÷ (4) =	14.9	(273)
EI rating (section 14)		89	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3179.02	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1951.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5130.08	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	816.31	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1368.14	(269)
‘Total Primary Energy			sum of (265)…(271) =		4808.5	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		83.9	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 7 - PV

Address : Flat 7, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.31	(1a)	x	2.3	(2a)	=	131.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	57.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	131.81	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Windows Type 2			6.47	x1/[1/(1.4)+ 0.04]		=	8.58			(27)
Walls	42.69	12.84	29.85	x	0.18	=	5.37			(29)
Roof	57.31	0	57.31	x	0.13	=	7.45			(30)
Total area of elements, m²			100							(31)
Party wall			29.49	x	0	=	0			(32)
Party floor			57.31							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5353.14 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.87 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.99 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.87	25.71	25.55	24.82	24.68	24.04	24.04	23.92	24.29	24.68	24.96	25.25	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	70.86	70.7	70.55	69.81	69.67	69.03	69.03	68.91	69.28	69.67	69.95	70.24	

Average = Sum(39)$_{1…12}$ /12= 69.81 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.24	1.23	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23

Average = Sum(40)$_{1\ldots12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.9 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 79.44 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	87.38	84.2	81.02	77.85	74.67	71.49	71.49	74.67	77.85	81.02	84.2	87.38

Total = Sum(44)$_{1\ldots12}$ = 953.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	129.58	113.33	116.95	101.96	97.83	84.42	78.23	89.77	90.84	105.87	115.56	125.49

Total = Sum(45)$_{1\ldots12}$ = 1249.83 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.44	17	17.54	15.29	14.67	12.66	11.73	13.47	13.63	15.88	17.33	18.82	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	44.53	38.76	41.29	38.39	38.05	35.26	36.43	38.05	38.39	41.29	41.52	44.53	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02	

Output from water heater (annual)$_{1...12}$ 1726.31 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	54.22	47.37	49.21	43.5	42.04	36.88	35.12	39.36	39.8	45.52	48.81	52.86	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	95.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.06	13.37	10.88	8.23	6.15	5.2	5.61	7.3	9.8	12.44	14.52	15.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	166.12	167.84	163.5	154.25	142.57	131.6	124.27	122.55	126.89	136.14	147.81	158.79	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	32.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	-76.19	(71)

Water heating gains (Table 5)

(72)m=	72.87	70.49	66.14	60.41	56.51	51.23	47.2	52.9	55.28	61.19	67.78	71.05	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	308.61	306.28	295.08	277.47	259.81	242.6	231.66	237.32	246.54	264.33	284.69	299.88	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.47	x	10.63	x	0.63	x	0.7	=	21.03	(74)
North	0.9x	0.77	x	6.47	x	20.32	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	6.47	x	34.53	x	0.63	x	0.7	=	68.28	(74)
North	0.9x	0.77	x	6.47	x	55.46	x	0.63	x	0.7	=	109.67	(74)
North	0.9x	0.77	x	6.47	x	74.72	x	0.63	x	0.7	=	147.74	(74)

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North	0.9x	0.77	x	6.47	x	79.99	x	0.63	x	0.7	=	158.16	(74)
North	0.9x	0.77	x	6.47	x	74.68	x	0.63	x	0.7	=	147.66	(74)
North	0.9x	0.77	x	6.47	x	59.25	x	0.63	x	0.7	=	117.15	(74)
North	0.9x	0.77	x	6.47	x	41.52	x	0.63	x	0.7	=	82.09	(74)
North	0.9x	0.77	x	6.47	x	24.19	x	0.63	x	0.7	=	47.83	(74)
North	0.9x	0.77	x	6.47	x	13.12	x	0.63	x	0.7	=	25.94	(74)
North	0.9x	0.77	x	6.47	x	8.86	x	0.63	x	0.7	=	17.53	(74)
West	0.9x	0.77	x	4.16	x	19.64	x	0.63	x	0.7	=	24.97	(80)
West	0.9x	0.77	x	4.16	x	38.42	x	0.63	x	0.7	=	48.85	(80)
West	0.9x	0.77	x	4.16	x	63.27	x	0.63	x	0.7	=	80.44	(80)
West	0.9x	0.77	x	4.16	x	92.28	x	0.63	x	0.7	=	117.32	(80)
West	0.9x	0.77	x	4.16	x	113.09	x	0.63	x	0.7	=	143.78	(80)
West	0.9x	0.77	x	4.16	x	115.77	x	0.63	x	0.7	=	147.18	(80)
West	0.9x	0.77	x	4.16	x	110.22	x	0.63	x	0.7	=	140.13	(80)
West	0.9x	0.77	x	4.16	x	94.68	x	0.63	x	0.7	=	120.37	(80)
West	0.9x	0.77	x	4.16	x	73.59	x	0.63	x	0.7	=	93.56	(80)
West	0.9x	0.77	x	4.16	x	45.59	x	0.63	x	0.7	=	57.96	(80)
West	0.9x	0.77	x	4.16	x	24.49	x	0.63	x	0.7	=	31.13	(80)
West	0.9x	0.77	x	4.16	x	16.15	x	0.63	x	0.7	=	20.53	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	46	89.03	148.72	226.99	291.52	305.34	287.79	237.51	175.65	105.79	57.07	38.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	354.61	395.3	443.8	504.46	551.32	547.94	519.45	474.84	422.19	370.12	341.76	337.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.89	0.73	0.57	0.63	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.66	19.8	20.06	20.42	20.74	20.93	20.98	20.97	20.82	20.41	19.98	19.64	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.89	19.9	19.91	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.84	0.63	0.44	0.5	0.81	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.12	18.32	18.69	19.22	19.65	19.87	19.91	19.91	19.77	19.22	18.59	18.09	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	18.96	19.29	19.74	20.13	20.33	20.38	20.37	20.23	19.74	19.19	18.76	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.79	18.96	19.29	19.74	20.13	20.33	20.38	20.37	20.23	19.74	19.19	18.76		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.56	0.83	0.97	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	353.11	392.31	435.97	477.94	470.14	368.93	256	265.24	350.68	358.2	339.1	336.8		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1026.57	994.04	902	756.81	587.06	395.62	260.69	273.56	424.39	636.72	845.7	1022.73		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	501.06	404.36	346.73	200.79	86.99	0	0	0	0	207.22	364.76	510.33		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2622.23 (98)

Space heating requirement in kWh/m²/year 45.76 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	501.06	404.36	346.73	200.79	86.99	0	0	0	0	207.22	364.76	510.33		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	536.47	432.94	371.23	214.98	93.13	0	0	0	0	221.86	390.53	546.4		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2807.53	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	174.11	152.09	158.24	140.35	135.88	119.68	114.66	127.82	129.23	147.15	157.09	170.02		
Efficiency of water heater													80.3	(216)
(217)m=	87.56	87.4	86.97	85.95	83.96	80.3	80.3	80.3	80.3	85.91	87.1	87.65		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	198.84	174.02	181.94	163.29	161.84	149.04	142.79	159.18	160.93	171.28	180.35	193.99		
Total = Sum(219a)$_{1...12}$ =													2037.49	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2807.53

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Water heating fuel used			2037.49	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			265.9	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	606.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	440.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1046.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	138	(268)
Total CO2, kg/year		sum of (265)…(271) =		1223.45	(272)

TER = 21.35 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:51

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 56.12m²

Site Reference : Lawnwood House **Plot Reference:** Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.53 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	22.87 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North	4.88m²	
Windows facing: North	3.1m²	
Windows facing: East	1.65m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	
										Total = Sum(44)$_{1…12}$ =		943.38	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	
										Total = Sum(45)$_{1…12}$ =		1236.92	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	

Output from water heater (annual)$_{1...12}$ 1964.14 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.05	81.92	87.9	81.37	81.6	75.6	75.15	78.95	77.71	84.25	85.84	90.71	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	123.73	121.91	118.14	113.01	109.68	105	101.01	106.12	107.93	113.24	119.23	121.92	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	355.81	354.01	343.5	326.67	309.81	293.4	282.64	287.72	296.29	313.3	332.81	347.22	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	391.65	422.95	459.62	508.47	549.06	546.85	520.34	479.96	434.64	395.28	377.15	376.99	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.74	0.58	0.64	0.87	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.77	20.02	20.37	20.71	20.92	20.98	20.97	20.81	20.4	19.97	19.62	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.85	0.64	0.44	0.5	0.8	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.24	18.6	19.11	19.56	19.81	19.85	19.85	19.7	19.17	18.54	18.03	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.9	19.21	19.66	20.06	20.29	20.34	20.33	20.18	19.7	19.16	18.72	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.9	19.21	19.66	20.06	20.29	20.34	20.33	20.18	19.7	19.16	18.72	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.68	0.5	0.56	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	388.95	418.48	449.99	480.88	470.74	373.79	261.18	270.39	357.9	379.09	372.55	374.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1057.8	1023.15	927.06	776.8	602.22	406.14	267.23	280.5	435.93	655.96	872.23	1054.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	497.63	406.34	354.94	213.07	97.83	0	0	0	0	205.99	359.77	505.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2641.23 (98)

Space heating requirement in kWh/m²/year 47.06 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	497.63	406.34	354.94	213.07	97.83	0	0	0	0	205.99	359.77	505.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	199.13	162.6	142.03	85.26	39.15	0	0	0	0	82.43	143.96	202.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1056.92 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	
Efficiency of water heater													175.1 (216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	108.51	95.92	101.37	91.76	90.57	81.85	79.49	86.01	85.48	95.11	99.45	106.2

Total = Sum(219a)$_{1...12}$ = 1121.73 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1056.92	
Water heating fuel used		1121.73	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		30	(231)
Electricity for lighting		264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	548.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	582.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1130.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1283.48	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.87	(273)
EI rating (section 14)				83	(274)

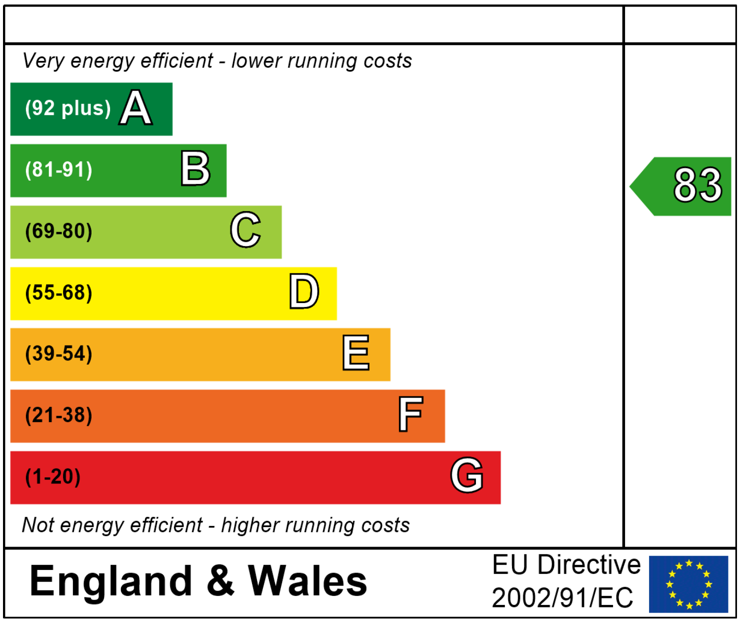
Predicted Energy Assessment

Flat 8 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	Dwelling type: Date of assessment: Produced by: Total floor area:	Top floor Flat 20 April 2020 Benjamin Leech 56.12 m²

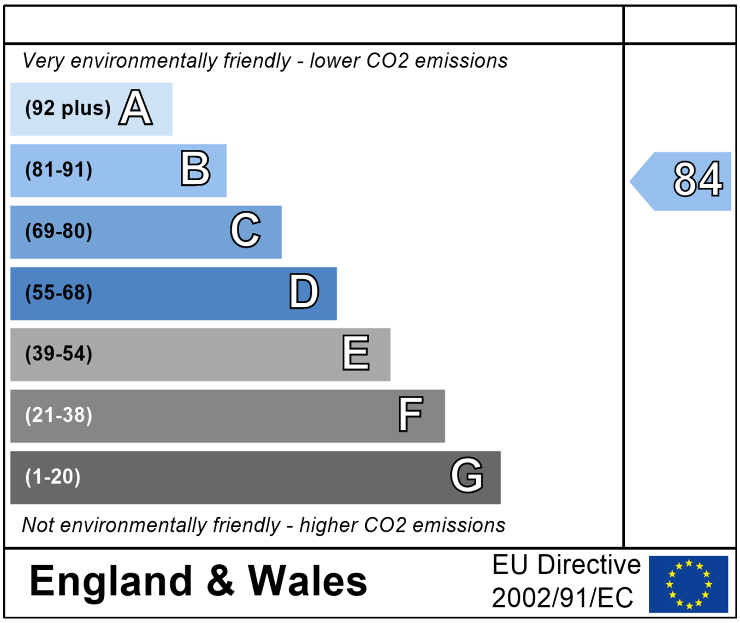
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)1…12 /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)1…12 = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)1…12 = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.82	0.67	0.74	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.63	19.88	20.25	20.61	20.87	20.96	20.94	20.72	20.28	19.83	19.48	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.6	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.6	18.86	19.23	19.58	19.8	19.85	19.85	19.69	19.26	18.81	18.46	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.58	0.66	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.87	332.2	368.17	410.21	421.84	353.39	255.57	260.58	314.15	303.78	287.51	287.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1070.72	1033.84	933.46	777.74	600.03	404.48	266.65	279.52	432.69	655.75	879.14	1067.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.77	471.51	420.58	264.62	132.57	0	0	0	0	261.86	425.97	580.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3130.72 (98)

Space heating requirement in kWh/m²/year 55.79 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	671.35	528.51	541.9	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.78	0.86	0.82	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	525.43	454.26	442.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	62.42	94.64	67.69	0	0	0	0

Total = Sum(104)$_{6...8}$ = 224.75 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	15.6	23.66	16.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 56.19 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.79 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)1…12 /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	
											Total = Sum(44)1…12 =	943.38	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	
											Total = Sum(45)1…12 =	1236.92	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.79	0.63	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.74	19.98	20.34	20.68	20.91	20.98	20.96	20.77	20.35	19.93	19.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.77	19.02	19.38	19.7	19.89	19.93	19.92	19.79	19.39	18.97	18.63	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.63	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.91	332.24	368.14	409.41	417.51	342.62	243.62	250.04	310.5	303.58	287.55	287.06	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1006.02	971.34	877.19	730.72	563.89	379.82	250.75	262.91	407.09	616.41	825.72	1002.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	524.6	429.48	378.73	231.34	108.91	0	0	0	0	232.75	387.49	532.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2825.63 (98)

Space heating requirement in kWh/m²/year 50.35 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	623.23	490.63	502.99	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.22	438.21	429.84	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	71.21	106.58	76.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 254.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	17.8	26.65	19.23	0	0	0	0

	Total = Sum(107) =	63.68	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.13	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	51.48	(109)
Target Fabric Energy Efficiency (TFEE)		59.21	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29	

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = Sum(44)$_{1...12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	

Total = Sum(45)$_{1...12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	

Output from water heater (annual)1…12 1964.14 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.05	81.92	87.9	81.37	81.6	75.6	75.15	78.95	77.71	84.25	85.84	90.71	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.42	33.24	27.03	20.46	15.3	12.91	13.95	18.14	24.35	30.91	36.08	38.46	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	243.38	245.91	239.54	226	208.89	192.82	182.08	179.55	185.92	199.47	216.57	232.64	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	123.73	121.91	118.14	113.01	109.68	105	101.01	106.12	107.93	113.24	119.23	121.92	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	493.02	489.55	473.21	447.96	422.37	399.22	385.54	392.3	406.69	432.11	460.37	481.52	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	528.86	558.48	589.32	629.76	661.61	652.67	623.24	584.53	545.04	514.09	504.71	511.28	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.83	0.65	0.49	0.54	0.78	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.98	20.21	20.53	20.8	20.95	20.99	20.98	20.89	20.56	20.16	19.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.9	0.77	0.56	0.37	0.42	0.69	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.54	18.87	19.32	19.67	19.83	19.86	19.86	19.78	19.38	18.82	18.34	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.16	19.45	19.84	20.16	20.32	20.35	20.35	20.26	19.89	19.4	18.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.16	19.45	19.84	20.16	20.32	20.35	20.35	20.26	19.89	19.4	18.98	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.42	0.47	0.73	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	518.06	542.87	561.52	567.09	520.19	389.56	264.64	276.32	395.73	468.32	487.83	502.16	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1077.53	1042.19	944.18	789.87	609.37	408.23	267.7	281.29	441.2	669.47	889.74	1073.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	416.24	335.54	284.7	160.4	66.35	0	0	0	0	149.66	289.37	425.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2127.53 (98)

Space heating requirement in kWh/m²/year 37.91 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	416.24	335.54	284.7	160.4	66.35	0	0	0	0	149.66	289.37	425.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	166.56	134.27	113.93	64.19	26.55	0	0	0	0	59.89	115.8	170.17	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 851.35 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96

Efficiency of water heater 175.1 (216)

(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	108.51	95.92	101.37	91.76	90.57	81.85	79.49	86.01	85.48	95.11	99.45	106.2

Total = Sum(219a)$_{1...12}$ = 1121.73 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		851.35	
Water heating fuel used		1121.73	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		30	(231)
Electricity for lighting		264.35	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	112.29	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	147.96	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	34.87	(250)
Additional standing charges (Table 12)				0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 299.07 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.24	(257)
SAP rating (Section 12)		82.67	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	441.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)

Water heating	(219) x	0.519	=	582.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1024.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1176.79	(272)
CO2 emissions per m²		(272) ÷ (4) =		20.97	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2613.66	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3443.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6057.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	811.55	(268)
'Total Primary Energy		sum of (265)…(271) =		6961	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		124.04	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94	

Output from water heater (annual)$_{1...12}$ 1846.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.04	74.68	79.88	73.61	73.59	67.84	67.14	70.94	69.95	76.23	78.09	82.69	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	112.95	111.14	107.37	102.24	98.91	94.22	90.24	95.35	97.16	102.47	108.46	111.15	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	345.04	343.24	332.73	315.89	299.04	282.63	271.87	276.95	285.51	302.52	322.04	336.45	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	380.88	412.18	448.84	497.69	538.28	536.08	509.57	469.18	423.87	384.51	366.38	366.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.88	0.72	0.56	0.62	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.75	19.87	20.11	20.45	20.76	20.94	20.99	20.98	20.84	20.47	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.84	0.63	0.43	0.49	0.79	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.25	18.43	18.78	19.27	19.69	19.89	19.93	19.93	19.8	19.31	18.71	18.23	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.05	19.35	19.78	20.15	20.35	20.39	20.38	20.25	19.81	19.29	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.9	19.05	19.35	19.78	20.15	20.35	20.39	20.38	20.25	19.81	19.29	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.94	0.85	0.67	0.48	0.55	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	378.55	408.19	439.84	470.3	457.45	357.27	247.12	256.56	345.9	369.1	362.31	364.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	994.52	961.87	871.55	729.89	565.59	380.94	251.1	263.53	409.55	616.44	819.5	990.75	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	458.28	372.07	321.19	186.9	80.46	0	0	0	0	184.02	329.18	466.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2398.13 (98)

Space heating requirement in kWh/m²/year 42.73 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	458.28	372.07	321.19	186.9	80.46	0	0	0	0	184.02	329.18	466.03	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	490.14	397.94	343.52	199.89	86.05	0	0	0	0	196.81	352.06	498.43	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2564.84 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94

Efficiency of water heater 79.8 (216)

(217)m=	87.2	87.01	86.52	85.38	83.26	79.8	79.8	79.8	79.8	85.25	86.63	87.29	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	206.4	182.63	193.57	176.83	178.44	167.45	161.86	176.17	175.41	183.61	189.82	201.55

Total = Sum(219a)$_{1...12}$ = 2193.76 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2564.84	
Water heating fuel used		2193.76	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	554.01	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	473.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1027.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1203.98	(272)

TER = 31.53 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:41

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 56.12m²

Site Reference : Lawnwood House **Plot Reference:** Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.53 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.37 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Heat pumps with radiators or underfloor heating - electric
Air source heat pump with flow temperature <= 35°C

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North	4.88m²	
Windows facing: North	3.1m²	
Windows facing: East	1.65m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	

Output from water heater (annual)$_{1...12}$ 1964.14 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.05	81.92	87.9	81.37	81.6	75.6	75.15	78.95	77.71	84.25	85.84	90.71	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	123.73	121.91	118.14	113.01	109.68	105	101.01	106.12	107.93	113.24	119.23	121.92	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	355.81	354.01	343.5	326.67	309.81	293.4	282.64	287.72	296.29	313.3	332.81	347.22	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	391.65	422.95	459.62	508.47	549.06	546.85	520.34	479.96	434.64	395.28	377.15	376.99	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.74	0.58	0.64	0.87	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.64	19.77	20.02	20.37	20.71	20.92	20.98	20.97	20.81	20.4	19.97	19.62	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85		(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.98	0.95	0.85	0.64	0.44	0.5	0.8	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.05	18.24	18.6	19.11	19.56	19.81	19.85	19.85	19.7	19.17	18.54	18.03	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.9	19.21	19.66	20.06	20.29	20.34	20.33	20.18	19.7	19.16	18.72	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.9	19.21	19.66	20.06	20.29	20.34	20.33	20.18	19.7	19.16	18.72	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.86	0.68	0.5	0.56	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	388.95	418.48	449.99	480.88	470.74	373.79	261.18	270.39	357.9	379.09	372.55	374.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1057.8	1023.15	927.06	776.8	602.22	406.14	267.23	280.5	435.93	655.96	872.23	1054.45	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	497.63	406.34	354.94	213.07	97.83	0	0	0	0	205.99	359.77	505.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2641.23 (98)

Space heating requirement in kWh/m²/year 47.06 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	497.63	406.34	354.94	213.07	97.83	0	0	0	0	205.99	359.77	505.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	199.13	162.6	142.03	85.26	39.15	0	0	0	0	82.43	143.96	202.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1056.92 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96

Efficiency of water heater 175.1 (216)

(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	108.51	95.92	101.37	91.76	90.57	81.85	79.49	86.01	85.48	95.11	99.45	106.2

Total = Sum(219a)$_{1...12}$ = 1121.73 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1056.92	
Water heating fuel used		1121.73	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		30	(231)
Electricity for lighting		264.35	(232)
Electricity generated by PVs		-594.71	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	548.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	582.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1130.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Energy saving/generation technologies Item 1		0.519	=	-308.65	(269)
Total CO2, kg/year	sum of (265)…(271) =			974.83	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.37	(273)
EI rating (section 14)				87	(274)

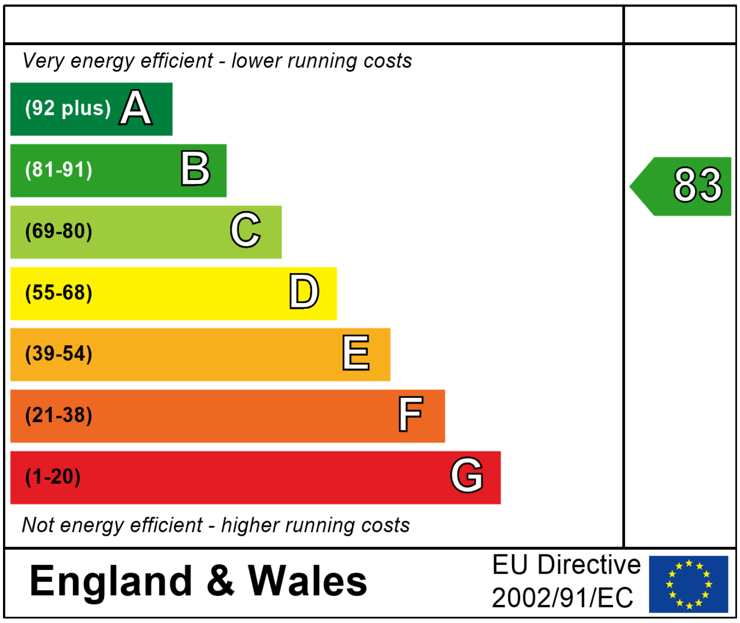
Predicted Energy Assessment

Flat 8	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	56.12 m²
BS5 0EF		

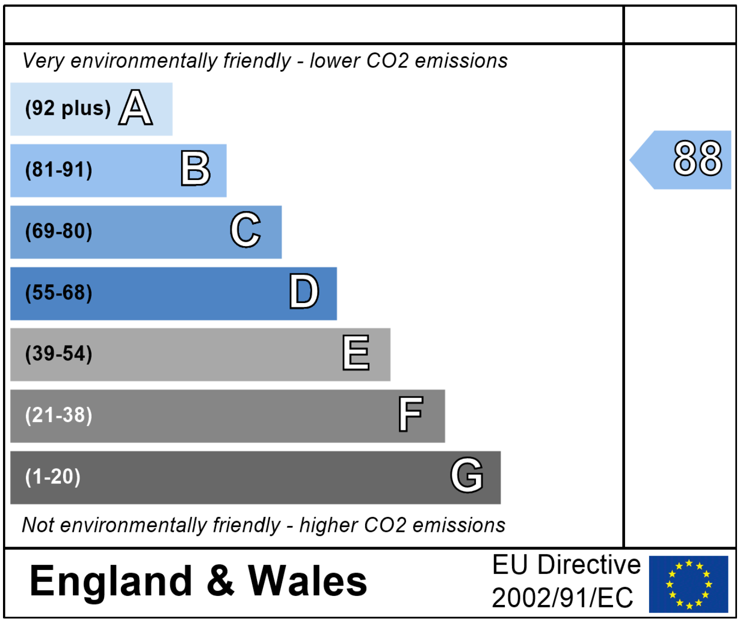
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

DFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29	

Average = Sum(40)1…12 /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = Sum(44)1…12 = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	

Total = Sum(45)1…12 = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)1…12 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.82	0.67	0.74	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.63	19.88	20.25	20.61	20.87	20.96	20.94	20.72	20.28	19.83	19.48	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.6	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.6	18.86	19.23	19.58	19.8	19.85	19.85	19.69	19.26	18.81	18.46	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.58	0.66	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.87	332.2	368.17	410.21	421.84	353.39	255.57	260.58	314.15	303.78	287.51	287.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1070.72	1033.84	933.46	777.74	600.03	404.48	266.65	279.52	432.69	655.75	879.14	1067.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.77	471.51	420.58	264.62	132.57	0	0	0	0	261.86	425.97	580.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3130.72 (98)

Space heating requirement in kWh/m²/year 55.79 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	671.35	528.51	541.9	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.78	0.86	0.82	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	525.43	454.26	442.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	62.42	94.64	67.69	0	0	0	0

Total = Sum(104)$_{6...8}$ = 224.75 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	15.6	23.66	16.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 56.19 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.79 (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.79	0.63	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.74	19.98	20.34	20.68	20.91	20.98	20.96	20.77	20.35	19.93	19.6	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.77	19.02	19.38	19.7	19.89	19.93	19.92	19.79	19.39	18.97	18.63	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.63	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.91	332.24	368.14	409.41	417.51	342.62	243.62	250.04	310.5	303.58	287.55	287.06	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1006.02	971.34	877.19	730.72	563.89	379.82	250.75	262.91	407.09	616.41	825.72	1002.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	524.6	429.48	378.73	231.34	108.91	0	0	0	0	232.75	387.49	532.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2825.63 (98)

Space heating requirement in kWh/m²/year 50.35 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	623.23	490.63	502.99	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.22	438.21	429.84	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	71.21	106.58	76.94	0	0	0	0

Total = Sum(104)$_{6...8}$ = 254.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	17.8	26.65	19.23	0	0	0	0

	Total = Sum(107) =	63.68	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.13	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	51.48	(109)
Target Fabric Energy Efficiency (TFEE)		59.21	(109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.12	(1a) x	2.3	(2a) =	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29	

Average = Sum(40)$_{1\ldots12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = Sum(44)$_{1\ldots12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	

Total = Sum(45)$_{1\ldots12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	

Output from water heater (annual)$_{1...12}$ 1964.14 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.05	81.92	87.9	81.37	81.6	75.6	75.15	78.95	77.71	84.25	85.84	90.71	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	37.42	33.24	27.03	20.46	15.3	12.91	13.95	18.14	24.35	30.91	36.08	38.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	243.38	245.91	239.54	226	208.89	192.82	182.08	179.55	185.92	199.47	216.57	232.64	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)
Water heating gains (Table 5)													
(72)m=	123.73	121.91	118.14	113.01	109.68	105	101.01	106.12	107.93	113.24	119.23	121.92	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	493.02	489.55	473.21	447.96	422.37	399.22	385.54	392.3	406.69	432.11	460.37	481.52	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	528.86	558.48	589.32	629.76	661.61	652.67	623.24	584.53	545.04	514.09	504.71	511.28	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.83	0.65	0.49	0.54	0.78	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	19.98	20.21	20.53	20.8	20.95	20.99	20.98	20.89	20.56	20.16	19.83	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.98	0.96	0.9	0.77	0.56	0.37	0.42	0.69	0.91	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.54	18.87	19.32	19.67	19.83	19.86	19.86	19.78	19.38	18.82	18.34	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.16	19.45	19.84	20.16	20.32	20.35	20.35	20.26	19.89	19.4	18.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.16	19.45	19.84	20.16	20.32	20.35	20.35	20.26	19.89	19.4	18.98	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.79	0.6	0.42	0.47	0.73	0.91	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	518.06	542.87	561.52	567.09	520.19	389.56	264.64	276.32	395.73	468.32	487.83	502.16	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1077.53	1042.19	944.18	789.87	609.37	408.23	267.7	281.29	441.2	669.47	889.74	1073.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	416.24	335.54	284.7	160.4	66.35	0	0	0	0	149.66	289.37	425.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2127.53 (98)

Space heating requirement in kWh/m²/year 37.91 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	416.24	335.54	284.7	160.4	66.35	0	0	0	0	149.66	289.37	425.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	166.56	134.27	113.93	64.19	26.55	0	0	0	0	59.89	115.8	170.17	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 851.35 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

	190.01	167.95	177.5	160.68	158.59	143.32	139.18	150.61	149.67	166.54	174.14	185.96	
Efficiency of water heater													175.1 (216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	108.51	95.92	101.37	91.76	90.57	81.85	79.49	86.01	85.48	95.11	99.45	106.2

Total = $Sum(219a)_{1...12}$ = 1121.73 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			851.35	
Water heating fuel used			1121.73	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			264.35	(232)
Electricity generated by PVs			-594.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	112.29	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	147.96	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	34.87	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 299.07 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.24	(257)
SAP rating (Section 12)		82.67	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

Space heating (main system 1)	(211) x	0.519	=	441.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	582.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1024.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-308.65	(269)
Total CO2, kg/year		sum of (265)…(271) =		868.14	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.47	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2613.66	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3443.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6057.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	811.55	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1825.75	(269)
'Total Primary Energy		sum of (265)…(271) =		5135.25	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		91.5	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - ASHP + PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94	

Output from water heater (annual)$_{1…12}$ 1846.19 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.04	74.68	79.88	73.61	73.59	67.84	67.14	70.94	69.95	76.23	78.09	82.69	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	112.95	111.14	107.37	102.24	98.91	94.22	90.24	95.35	97.16	102.47	108.46	111.15	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	345.04	343.24	332.73	315.89	299.04	282.63	271.87	276.95	285.51	302.52	322.04	336.45	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	380.88	412.18	448.84	497.69	538.28	536.08	509.57	469.18	423.87	384.51	366.38	366.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.88	0.72	0.56	0.62	0.86	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.75	19.87	20.11	20.45	20.76	20.94	20.99	20.98	20.84	20.47	20.05	19.73	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.84	0.63	0.43	0.49	0.79	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.25	18.43	18.78	19.27	19.69	19.89	19.93	19.93	19.8	19.31	18.71	18.23	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.9	19.05	19.35	19.78	20.15	20.35	20.39	20.38	20.25	19.81	19.29	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.9	19.05	19.35	19.78	20.15	20.35	20.39	20.38	20.25	19.81	19.29	18.88	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.94	0.85	0.67	0.48	0.55	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	378.55	408.19	439.84	470.3	457.45	357.27	247.12	256.56	345.9	369.1	362.31	364.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	994.52	961.87	871.55	729.89	565.59	380.94	251.1	263.53	409.55	616.44	819.5	990.75	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	458.28	372.07	321.19	186.9	80.46	0	0	0	0	184.02	329.18	466.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2398.13 (98)

Space heating requirement in kWh/m²/year 42.73 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	458.28	372.07	321.19	186.9	80.46	0	0	0	0	184.02	329.18	466.03	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	490.14	397.94	343.52	199.89	86.05	0	0	0	0	196.81	352.06	498.43	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2564.84 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

179.99	158.9	167.49	150.98	148.57	133.63	129.17	140.59	139.98	156.52	164.44	175.94

Efficiency of water heater 79.8 (216)

(217)m=	87.2	87.01	86.52	85.38	83.26	79.8	79.8	79.8	79.8	85.25	86.63	87.29	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	206.4	182.63	193.57	176.83	178.44	167.45	161.86	176.17	175.41	183.61	189.82	201.55

Total = $Sum(219a)_{1...12}$ = 2193.76 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2564.84	
Water heating fuel used		2193.76	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	554.01	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	473.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1027.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1203.98	(272)

TER = 31.53 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:32:01

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 56.12m²

Site Reference : Lawnwood House **Plot Reference:** Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.53 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.35 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North	4.88m²
Windows facing: North	3.1m²
Windows facing: East	1.65m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	29.13	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7237.28	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		18.71	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	47.85	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1...12}$ /12= 72.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1…12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	
										Total = Sum(44)$_{1…12}$ =		943.38	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	
										Total = Sum(45)$_{1…12}$ =		1236.92	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.55	13.12	14.5	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	

Output from water heater (annual)1…12 | 1407.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.28	40.57	42.11	37.05	35.8	31.26	29.34	33.14	33.38	38.45	41.54	44.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	62.2	60.38	56.6	51.46	48.12	43.42	39.43	44.55	46.37	51.69	57.69	60.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	294.29	292.48	281.95	265.11	248.25	231.83	221.06	226.16	234.72	251.74	271.28	285.7	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	330.12	361.42	398.07	446.91	487.49	485.27	458.76	418.39	373.08	333.73	315.62	315.46	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.8	0.64	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.67	19.92	20.29	20.64	20.89	20.97	20.95	20.75	20.31	19.87	19.52	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.09	18.46	18.99	19.48	19.78	19.85	19.84	19.64	19.04	18.4	17.88	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.62	18.78	19.09	19.55	19.99	20.26	20.33	20.32	20.12	19.59	19.04	18.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.47	18.63	18.94	19.4	19.84	20.11	20.18	20.17	19.97	19.44	18.89	18.44	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.73	0.54	0.61	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.89	359.2	392.81	429.9	433	352.87	248.14	255.48	323.77	325.42	313.53	314.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1037.71	1003.2	907.43	758.34	586.23	393.46	255.99	268.92	420.72	637.09	852.49	1034.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	527.36	432.77	382.88	236.48	114	0	0	0	0	231.89	388.05	535.67	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2849.09 (98)

Space heating requirement in kWh/m²/year 50.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	527.36	432.77	382.88	236.48	114	0	0	0	0	231.89	388.05	535.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	582.72	478.2	423.07	261.3	125.97	0	0	0	0	256.23	428.78	591.9	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3148.17 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73

Efficiency of water heater 87.3 (216)

(217)m=	89.8	89.76	89.67	89.43	88.89	87.3	87.3	87.3	87.3	89.39	89.68	89.82	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.01	139.57	145.25	128.48	125.16	111.67	105.16	118.28	118.98	133.4	143.18	154.45

Total = Sum(219a)$_{1...12}$ = 1582.58 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3148.17	
Water heating fuel used			1582.58	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	680	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	341.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1021.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1197.96	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.35	(273)
EI rating (section 14)				84	(274)

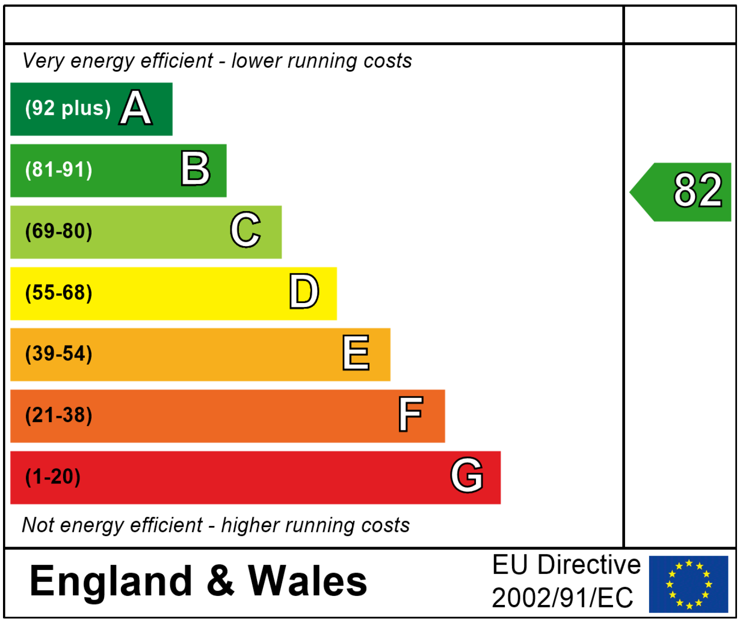
Predicted Energy Assessment

Flat 8 Lawnwood House, Lawnwood Road Industrial Estate Lawnwood Road Bristol BS5 0EF	
Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	56.12 m²

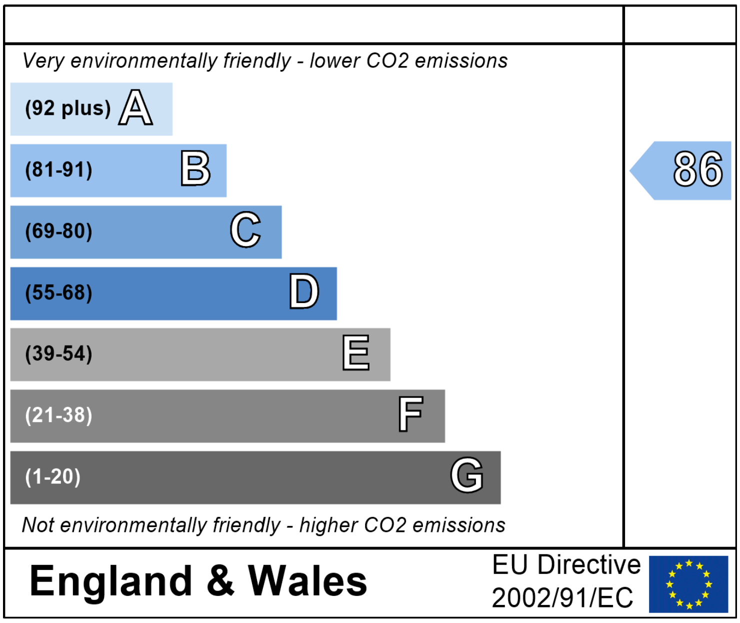
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1...12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1...12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.82	0.67	0.74	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.63	19.88	20.25	20.61	20.87	20.96	20.94	20.72	20.28	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.6	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.6	18.86	19.23	19.58	19.8	19.85	19.85	19.69	19.26	18.81	18.46	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.58	0.66	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.87	332.2	368.17	410.21	421.84	353.39	255.57	260.58	314.15	303.78	287.51	287.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1070.72	1033.84	933.46	777.74	600.03	404.48	266.65	279.52	432.69	655.75	879.14	1067.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.77	471.51	420.58	264.62	132.57	0	0	0	0	261.86	425.97	580.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3130.72 (98)

Space heating requirement in kWh/m²/year 55.79 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	671.35	528.51	541.9	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.78	0.86	0.82	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	525.43	454.26	442.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	62.42	94.64	67.69	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 224.75 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	15.6	23.66	16.92	0	0	0	0

	Total = Sum(107) =	56.19	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	56.79	(109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88		x1/[1/(1.4)+ 0.04]	=	6.47			(27)
Windows Type 2			3.1		x1/[1/(1.4)+ 0.04]	=	4.11			(27)
Windows Type 3			1.65		x1/[1/(1.4)+ 0.04]	=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

TFEE WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2	

Average = $Sum(40)_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = $Sum(44)_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	

Total = $Sum(45)_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57

Output from water heater (annual)$_{1...12}$ | 1051.38 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.79	0.63	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.74	19.98	20.34	20.68	20.91	20.98	20.96	20.77	20.35	19.93	19.6	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.77	19.02	19.38	19.7	19.89	19.93	19.92	19.79	19.39	18.97	18.63	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.63	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.91	332.24	368.14	409.41	417.51	342.62	243.62	250.04	310.5	303.58	287.55	287.06	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1006.02	971.34	877.19	730.72	563.89	379.82	250.75	262.91	407.09	616.41	825.72	1002.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	524.6	429.48	378.73	231.34	108.91	0	0	0	0	232.75	387.49	532.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2825.63 (98)

Space heating requirement in kWh/m²/year 50.35 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	623.23	490.63	502.99	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.22	438.21	429.84	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	71.21	106.58	76.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 254.73 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	17.8	26.65	19.23	0	0	0	0

	Total = Sum(107) =	63.68	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.13	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	51.48	(109)
Target Fabric Energy Efficiency (TFEE)		59.21	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29	

Average = Sum(40)$_{1\ldots12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = Sum(44)$_{1\ldots12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2	

Total = Sum(45)$_{1\ldots12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.55	13.12	14.5	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	

Output from water heater (annual)$_{1...12}$ 1407.25 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.28	40.57	42.11	37.05	35.8	31.26	29.34	33.14	33.38	38.45	41.54	44.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	37.42	33.24	27.03	20.46	15.3	12.91	13.95	18.14	24.35	30.91	36.08	38.46	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	243.38	245.91	239.54	226	208.89	192.82	182.08	179.55	185.92	199.47	216.57	232.64	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)
Water heating gains (Table 5)													
(72)m=	62.2	60.38	56.6	51.46	48.12	43.42	39.43	44.55	46.37	51.69	57.69	60.39	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	431.5	428.02	411.66	386.41	360.8	337.65	323.96	330.73	345.12	370.56	398.83	419.99	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	467.33	496.95	527.78	568.21	600.05	591.09	561.66	522.96	483.48	452.54	443.17	449.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.86	0.7	0.54	0.6	0.83	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.88	20.12	20.45	20.75	20.93	20.98	20.98	20.85	20.48	20.07	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.81	0.61	0.41	0.46	0.75	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.23	18.4	18.74	19.22	19.61	19.82	19.86	19.85	19.74	19.27	18.68	18.2	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.89	19.04	19.34	19.75	20.11	20.3	20.34	20.34	20.22	19.8	19.29	18.86	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.89	19.19	19.6	19.96	20.15	20.19	20.19	20.07	19.65	19.14	18.71	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.92	0.82	0.63	0.45	0.5	0.77	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	460.91	487.23	509.48	523.67	490.91	373.58	253.01	263.98	371.62	422.97	433.15	444.48	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1057.82	1022.75	925.35	772.76	595	396.46	256.75	270.21	427.88	652.04	870.63	1054.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	444.1	359.87	309.41	179.34	77.44	0	0	0	0	170.43	314.99	453.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2309.16 (98)

Space heating requirement in kWh/m²/year 41.15 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	444.1	359.87	309.41	179.34	77.44	0	0	0	0	170.43	314.99	453.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	490.72	397.64	341.89	198.17	85.57	0	0	0	0	188.32	348.05	501.19		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2551.56	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

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Water heating

Output from water heater (calculated above)

	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73

Efficiency of water heater 87.3 (216)

(217)m=	89.7	89.65	89.53	89.22	88.59	87.3	87.3	87.3	87.3	89.15	89.55	89.73	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.19	139.74	145.47	128.77	125.59	111.67	105.16	118.28	118.98	133.75	143.4	154.61

Total = Sum(219a)$_{1...12}$ = 1584.6 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2551.56	
Water heating fuel used		1584.6	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		264.35	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	88.79	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	55.14	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	34.87	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)...(254) = 308.7 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.11	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	551.14	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	342.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =			893.41	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1069.53	(272)
CO2 emissions per m²		(272) ÷ (4) =		19.06	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3112.9	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1933.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5046.11	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	811.55	(268)
'Total Primary Energy		sum of (265)…(271) =		6087.91	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		108.48	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - Baseline

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	44.07	38.36	40.86	37.99	37.66	34.89	36.06	37.66	37.99	40.86	41.1	44.07	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26	

Output from water heater (annual)1…12 | 1708.47 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	53.66	46.88	48.7	43.05	41.61	36.5	34.76	38.95	39.39	45.05	48.3	52.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	72.12	69.77	65.46	59.79	55.92	50.7	46.72	52.36	54.71	60.55	67.08	70.31	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	304.21	301.87	290.81	273.44	256.05	239.1	228.34	233.97	243.06	260.61	280.67	295.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	340.04	370.8	406.93	455.24	495.3	492.55	466.04	426.2	381.42	342.6	325.01	325.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.6	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.8	20.04	20.39	20.71	20.92	20.98	20.97	20.81	20.4	19.99	19.66	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.47	0.54	0.84	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.15	18.33	18.68	19.19	19.64	19.88	19.93	19.92	19.76	19.22	18.61	18.13	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.81	18.97	19.27	19.71	20.1	20.33	20.38	20.38	20.22	19.73	19.21	18.79	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.81	18.97	19.27	19.71	20.1	20.33	20.38	20.38	20.22	19.73	19.21	18.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.88	0.71	0.53	0.59	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	338.73	368.44	401.25	436.49	434.93	349.04	245.21	253.18	326.64	333.37	322.76	324.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	988.81	956.16	865.98	725.03	562.47	379.9	250.85	263.1	406.96	611.33	813.87	985.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	483.66	394.95	345.76	207.75	94.89	0	0	0	0	206.8	353.6	491.56	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2578.97 (98)

Space heating requirement in kWh/m²/year 45.95 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	483.66	394.95	345.76	207.75	94.89	0	0	0	0	206.8	353.6	491.56	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	517.84	422.86	370.19	222.43	101.59	0	0	0	0	221.41	378.59	526.29	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2761.21 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26

Efficiency of water heater — 80.3 (216)

(217)m=	87.51	87.37	86.99	86.06	84.19	80.3	80.3	80.3	80.3	85.93	87.06	87.59	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.9	172.28	180.03	161.39	159.73	147.5	141.31	157.53	159.27	169.47	178.58	192.1

Total = Sum(219a)$_{1...12}$ = 2016.1 (219)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		2761.21	
Water heating fuel used		2016.1	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		75	(231)
Electricity for lighting		264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	596.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	435.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1031.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1208.02	(272)

TER = 21.53 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:30

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 56.12m²

Site Reference : Lawnwood House **Plot Reference:** Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.53 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.31 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.2 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.47 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 459, product index 017956):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Ideal
Model: LOGIC COMBI
Model qualifier: ESP1 30
(Combi)
Efficiency 89.6 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: North	4.88m²
Windows facing: North	3.1m²
Windows facing: East	1.65m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.12	(1a) x	2.3	(2a) =	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = $\text{Sum}(40)_{1\dots12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = $\text{Sum}(44)_{1\dots12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = $\text{Sum}(45)_{1\dots12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.55	13.12	14.5	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	

Output from water heater (annual)$_{1...12}$ 1407.25 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.28	40.57	42.11	37.05	35.8	31.26	29.34	33.14	33.38	38.45	41.54	44.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)
Water heating gains (Table 5)													
(72)m=	62.2	60.38	56.6	51.46	48.12	43.42	39.43	44.55	46.37	51.69	57.69	60.39	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	294.29	292.48	281.95	265.11	248.25	231.83	221.06	226.16	234.72	251.74	271.28	285.7	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	330.12	361.42	398.07	446.91	487.49	485.27	458.76	418.39	373.08	333.73	315.62	315.46	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.92	0.8	0.64	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.55	19.67	19.92	20.29	20.64	20.89	20.97	20.95	20.75	20.31	19.87	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.09	18.46	18.99	19.48	19.78	19.85	19.84	19.64	19.04	18.4	17.88	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.62	18.78	19.09	19.55	19.99	20.26	20.33	20.32	20.12	19.59	19.04	18.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.47	18.63	18.94	19.4	19.84	20.11	20.18	20.17	19.97	19.44	18.89	18.44	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.73	0.54	0.61	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	328.89	359.2	392.81	429.9	433	352.87	248.14	255.48	323.77	325.42	313.53	314.5	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1037.71	1003.2	907.43	758.34	586.23	393.46	255.99	268.92	420.72	637.09	852.49	1034.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	527.36	432.77	382.88	236.48	114	0	0	0	0	231.89	388.05	535.67	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2849.09 (98)

Space heating requirement in kWh/m²/year 50.77 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	527.36	432.77	382.88	236.48	114	0	0	0	0	231.89	388.05	535.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	582.72	478.2	423.07	261.3	125.97	0	0	0	0	256.23	428.78	591.9	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3148.17 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73

Efficiency of water heater 87.3 (216)

(217)m=	89.8	89.76	89.67	89.43	88.89	87.3	87.3	87.3	87.3	89.39	89.68	89.82	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.01	139.57	145.25	128.48	125.16	111.67	105.16	118.28	118.98	133.4	143.18	154.45

Total = Sum(219a)$_{1...12}$ = 1582.58 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3148.17	
Water heating fuel used		1582.58	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		264.35	(232)
Electricity generated by PVs		-436.52	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	680	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	341.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1021.84	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	137.2	(268)
Energy saving/generation technologies Item 1			0.519	=	-226.56	(269)
Total CO2, kg/year			sum of (265)…(271) =		971.41	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.31	(273)
EI rating (section 14)					87	(274)

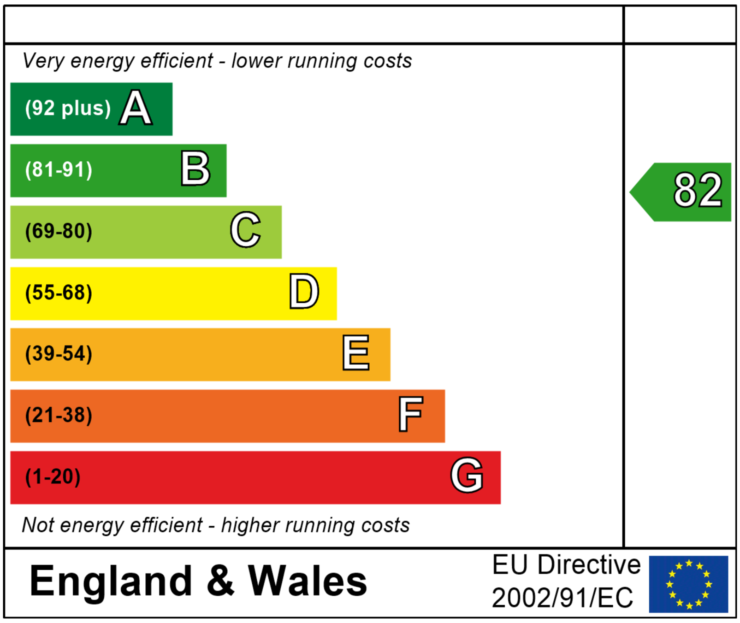
Predicted Energy Assessment

Flat 8	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	56.12 m²
BS5 0EF		

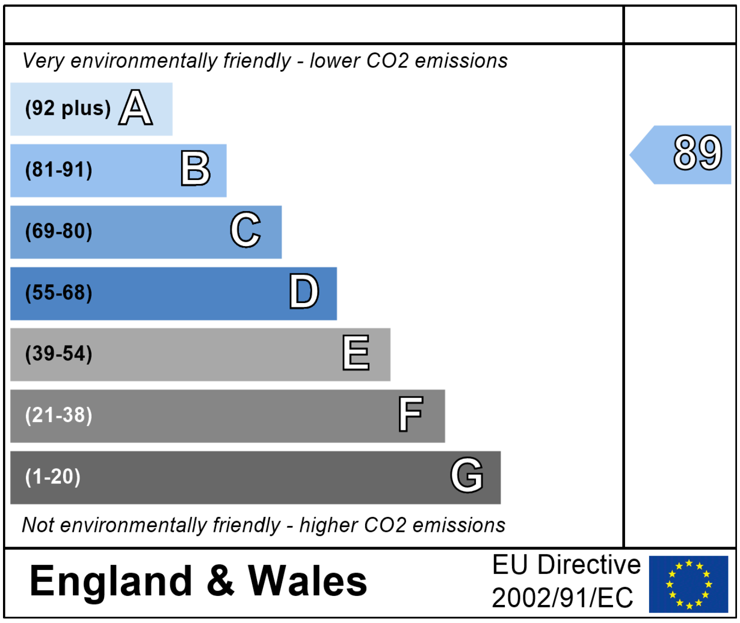
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1...12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1...12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.82	0.67	0.74	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.63	19.88	20.25	20.61	20.87	20.96	20.94	20.72	20.28	19.83	19.48	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.6	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.6	18.86	19.23	19.58	19.8	19.85	19.85	19.69	19.26	18.81	18.46	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.05	19.3	19.67	20.03	20.26	20.33	20.32	20.14	19.7	19.25	18.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.58	0.66	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.87	332.2	368.17	410.21	421.84	353.39	255.57	260.58	314.15	303.78	287.51	287.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1070.72	1033.84	933.46	777.74	600.03	404.48	266.65	279.52	432.69	655.75	879.14	1067.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	572.77	471.51	420.58	264.62	132.57	0	0	0	0	261.86	425.97	580.84	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3130.72 (98)

Space heating requirement in kWh/m²/year 55.79 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	671.35	528.51	541.9	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.78	0.86	0.82	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	525.43	454.26	442.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	62.42	94.64	67.69	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 224.75 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 0 (106)

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Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	15.6	23.66	16.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 56.19 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.79 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.12	(1a) x	2.3	(2a) =	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48	

Total = Sum(44)$_{1…12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1…12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	109.01	95.34	98.38	85.77	82.3	71.02	65.81	75.51	76.42	89.06	97.21	105.57	

Output from water heater (annual)$_{1...12}$ 1051.38 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	27.25	23.83	24.59	21.44	20.57	17.75	16.45	18.88	19.1	22.26	24.3	26.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	36.63	35.47	33.06	29.78	27.65	24.66	22.11	25.37	26.53	29.92	33.75	35.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	265.71	264.57	255.42	240.43	224.78	210.06	200.74	203.98	211.89	226.98	244.34	257.78	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	301.55	333.51	371.53	422.23	464.03	463.51	438.44	396.21	350.25	308.97	288.68	287.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.79	0.63	0.71	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.62	19.74	19.98	20.34	20.68	20.91	20.98	20.96	20.77	20.35	19.93	19.6	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.7	0.5	0.57	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.77	19.02	19.38	19.7	19.89	19.93	19.92	19.79	19.39	18.97	18.63	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.19	19.44	19.79	20.12	20.33	20.38	20.37	20.22	19.81	19.38	19.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.63	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	300.91	332.24	368.14	409.41	417.51	342.62	243.62	250.04	310.5	303.58	287.55	287.06	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1006.02	971.34	877.19	730.72	563.89	379.82	250.75	262.91	407.09	616.41	825.72	1002.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	524.6	429.48	378.73	231.34	108.91	0	0	0	0	232.75	387.49	532.34	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2825.63 (98)

Space heating requirement in kWh/m²/year 50.35 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	623.23	490.63	502.99	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.85	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.22	438.21	429.84	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	612.12	581.47	533.24	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	71.21	106.58	76.94	0	0	0	0

Total = $Sum(104)_{6...8}$ = 254.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

TFEE WorkSheet: New dwelling design stage

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	17.8	26.65	19.23	0	0	0	0

Total = Sum(107) = 63.68 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.13 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 51.48 (109)

Target Fabric Energy Efficiency (TFEE) 59.21 (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1.8	=	3.978			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.13 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.85 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.25	73.09	72.93	72.2	72.06	71.42	71.42	71.3	71.67	72.06	72.34	72.63	

Average = $Sum(39)_{1...12}$ /12= 72.2 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.29	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.29

Average = Sum(40)$_{1...12}$ /12= 1.29 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48

Total = Sum(44)$_{1...12}$ = 943.38 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2

Total = Sum(45)$_{1...12}$ = 1236.92 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.55	13.12	14.5	13.99	14.43	13.94	14.38	14.41	13.97	14.47	14.04	14.54	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73	

Output from water heater (annual)$_{1...12}$ 1407.25 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	46.28	40.57	42.11	37.05	35.8	31.26	29.34	33.14	33.38	38.45	41.54	44.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	112.21	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.42	33.24	27.03	20.46	15.3	12.91	13.95	18.14	24.35	30.91	36.08	38.46	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	243.38	245.91	239.54	226	208.89	192.82	182.08	179.55	185.92	199.47	216.57	232.64	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	62.2	60.38	56.6	51.46	48.12	43.42	39.43	44.55	46.37	51.69	57.69	60.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	431.5	428.02	411.66	386.41	360.8	337.65	323.96	330.73	345.12	370.56	398.83	419.99	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	467.33	496.95	527.78	568.21	600.05	591.09	561.66	522.96	483.48	452.54	443.17	449.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.86	0.7	0.54	0.6	0.83	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.76	19.88	20.12	20.45	20.75	20.93	20.98	20.98	20.85	20.48	20.07	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(88)m=	19.84	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.85		(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.81	0.61	0.41	0.46	0.75	0.94	0.98	0.99		(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.23	18.4	18.74	19.22	19.61	19.82	19.86	19.85	19.74	19.27	18.68	18.2		(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.89	19.04	19.34	19.75	20.11	20.3	20.34	20.34	20.22	19.8	19.29	18.86		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.89	19.19	19.6	19.96	20.15	20.19	20.19	20.07	19.65	19.14	18.71		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.97	0.92	0.82	0.63	0.45	0.5	0.77	0.93	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	460.91	487.23	509.48	523.67	490.91	373.58	253.01	263.98	371.62	422.97	433.15	444.48		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1057.82	1022.75	925.35	772.76	595	396.46	256.75	270.21	427.88	652.04	870.63	1054.13		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	444.1	359.87	309.41	179.34	77.44	0	0	0	0	170.43	314.99	453.58		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2309.16 (98)

Space heating requirement in kWh/m²/year 41.15 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	444.1	359.87	309.41	179.34	77.44	0	0	0	0	170.43	314.99	453.58		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	490.72	397.64	341.89	198.17	85.57	0	0	0	0	188.32	348.05	501.19		

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2551.56 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

	142.79	125.28	130.24	114.9	111.25	97.48	91.8	103.25	103.87	119.24	128.41	138.73		
Efficiency of water heater													87.3	(216)
(217)m=	89.7	89.65	89.53	89.22	88.59	87.3	87.3	87.3	87.3	89.15	89.55	89.73		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	159.19	139.74	145.47	128.77	125.59	111.67	105.16	118.28	118.98	133.75	143.4	154.61		
								Total = Sum(219a)$_{1...12}$ =					1584.6	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2551.56	
Water heating fuel used			1584.6	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			264.35	(232)
Electricity generated by PVs			-436.52	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	88.79	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	55.14	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a						
Energy for lighting	(232)		13.19	x 0.01 =	34.87	(250)
Additional standing charges (Table 12)					120	(251)
	one of (233) to (235) x)		13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed						
Total energy cost	(245)...(247) + (250)…(254) =				308.7	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.11	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	551.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	342.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =			893.41	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Energy saving/generation technologies Item 1		0.519	=	-226.56	(269)
Total CO2, kg/year	sum of (265)…(271) =			842.98	(272)
CO2 emissions per m²	(272) ÷ (4) =			15.02	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3112.9	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1933.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5046.11	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	811.55	(268)
Energy saving/generation technologies Item 1		3.07	=	-1340.13	(269)
'Total Primary Energy	sum of (265)…(271) =			4747.78	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			84.6	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 8 - PV

Address : Flat 8, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.12	(1a)	x	2.3	(2a)	=	129.08	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.12	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			129.08	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)					
Number of storeys in the dwelling (ns)				0	(9)
Additional infiltration			[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35					
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0				0	(12)
If no draught lobby, enter 0.05, else enter 0				0	(13)
Percentage of windows and doors draught stripped				0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =			0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =			0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used					
Number of sides sheltered				2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =			0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.21	x	1	=	2.21			(26)
Windows Type 1			4.88	x1/[1/(1.4)+ 0.04]		=	6.47			(27)
Windows Type 2			3.1	x1/[1/(1.4)+ 0.04]		=	4.11			(27)
Windows Type 3			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Walls	40.14	11.84	28.3	x	0.18	=	5.09			(29)
Roof	56.12	0	56.12	x	0.13	=	7.3			(30)
Total area of elements, m²			96.26							(31)
Party wall			30.46	x	0	=	0			(32)
Party floor			56.12							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 27.37 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7237.28 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 15.36 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.4	25.24	25.08	24.35	24.21	23.57	23.57	23.46	23.82	24.21	24.49	24.78	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.13	67.97	67.81	67.08	66.94	66.3	66.3	66.18	66.55	66.94	67.22	67.51	

Average = Sum(39)$_{1…12}$ /12= 67.08 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.21	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.2		
										Average = Sum(40)$_{1...12}$ /12=			1.2	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.87 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	86.48	83.33	80.19	77.04	73.9	70.75	70.75	73.9	77.04	80.19	83.33	86.48		
										Total = Sum(44)$_{1...12}$ =			943.38	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	128.24	112.16	115.74	100.9	96.82	83.55	77.42	88.84	89.9	104.77	114.37	124.2		
										Total = Sum(45)$_{1...12}$ =			1236.92	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	19.24	16.82	17.36	15.14	14.52	12.53	11.61	13.33	13.49	15.72	17.16	18.63		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	44.07	38.36	40.86	37.99	37.66	34.89	36.06	37.66	37.99	40.86	41.1	44.07	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26	

Output from water heater (annual)$_{1...12}$ 1708.47 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	53.66	46.88	48.7	43.05	41.61	36.5	34.76	38.95	39.39	45.05	48.3	52.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.97	13.29	10.81	8.19	6.12	5.17	5.58	7.26	9.74	12.36	14.43	15.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	163.07	164.76	160.49	151.42	139.96	129.19	121.99	120.3	124.57	133.64	145.1	155.87	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	-74.8	(71)

Water heating gains (Table 5)

(72)m=	72.12	69.77	65.46	59.79	55.92	50.7	46.72	52.36	54.71	60.55	67.08	70.31	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	304.21	301.87	290.81	273.44	256.05	239.1	228.34	233.97	243.06	260.61	280.67	295.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.88	x	10.63	x	0.63	x	0.7	=	15.86	(74)
North	0.9x	0.77	x	3.1	x	10.63	x	0.63	x	0.7	=	10.07	(74)
North	0.9x	0.77	x	4.88	x	20.32	x	0.63	x	0.7	=	30.31	(74)
North	0.9x	0.77	x	3.1	x	20.32	x	0.63	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	4.88	x	34.53	x	0.63	x	0.7	=	51.5	(74)

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North	0.9x	0.77	x	3.1	x	34.53	x	0.63	x	0.7	=	32.71	(74)
North	0.9x	0.77	x	4.88	x	55.46	x	0.63	x	0.7	=	82.72	(74)
North	0.9x	0.77	x	3.1	x	55.46	x	0.63	x	0.7	=	52.55	(74)
North	0.9x	0.77	x	4.88	x	74.72	x	0.63	x	0.7	=	111.43	(74)
North	0.9x	0.77	x	3.1	x	74.72	x	0.63	x	0.7	=	70.79	(74)
North	0.9x	0.77	x	4.88	x	79.99	x	0.63	x	0.7	=	119.29	(74)
North	0.9x	0.77	x	3.1	x	79.99	x	0.63	x	0.7	=	75.78	(74)
North	0.9x	0.77	x	4.88	x	74.68	x	0.63	x	0.7	=	111.37	(74)
North	0.9x	0.77	x	3.1	x	74.68	x	0.63	x	0.7	=	70.75	(74)
North	0.9x	0.77	x	4.88	x	59.25	x	0.63	x	0.7	=	88.36	(74)
North	0.9x	0.77	x	3.1	x	59.25	x	0.63	x	0.7	=	56.13	(74)
North	0.9x	0.77	x	4.88	x	41.52	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	3.1	x	41.52	x	0.63	x	0.7	=	39.33	(74)
North	0.9x	0.77	x	4.88	x	24.19	x	0.63	x	0.7	=	36.08	(74)
North	0.9x	0.77	x	3.1	x	24.19	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.88	x	13.12	x	0.63	x	0.7	=	19.56	(74)
North	0.9x	0.77	x	3.1	x	13.12	x	0.63	x	0.7	=	12.43	(74)
North	0.9x	0.77	x	4.88	x	8.86	x	0.63	x	0.7	=	13.22	(74)
North	0.9x	0.77	x	3.1	x	8.86	x	0.63	x	0.7	=	8.4	(74)
East	0.9x	0.77	x	1.65	x	19.64	x	0.63	x	0.7	=	9.9	(76)
East	0.9x	0.77	x	1.65	x	38.42	x	0.63	x	0.7	=	19.37	(76)
East	0.9x	0.77	x	1.65	x	63.27	x	0.63	x	0.7	=	31.91	(76)
East	0.9x	0.77	x	1.65	x	92.28	x	0.63	x	0.7	=	46.53	(76)
East	0.9x	0.77	x	1.65	x	113.09	x	0.63	x	0.7	=	57.03	(76)
East	0.9x	0.77	x	1.65	x	115.77	x	0.63	x	0.7	=	58.38	(76)
East	0.9x	0.77	x	1.65	x	110.22	x	0.63	x	0.7	=	55.58	(76)
East	0.9x	0.77	x	1.65	x	94.68	x	0.63	x	0.7	=	47.74	(76)
East	0.9x	0.77	x	1.65	x	73.59	x	0.63	x	0.7	=	37.11	(76)
East	0.9x	0.77	x	1.65	x	45.59	x	0.63	x	0.7	=	22.99	(76)
East	0.9x	0.77	x	1.65	x	24.49	x	0.63	x	0.7	=	12.35	(76)
East	0.9x	0.77	x	1.65	x	16.15	x	0.63	x	0.7	=	8.14	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	35.84	68.93	116.12	181.8	239.24	253.45	237.7	192.23	138.36	81.98	44.34	29.76	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	340.04	370.8	406.93	455.24	495.3	492.55	466.04	426.2	381.42	342.6	325.01	325.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.76	0.6	0.67	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.8	20.04	20.39	20.71	20.92	20.98	20.97	20.81	20.4	19.99	19.66	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.93	19.93	19.93	19.94	19.93	19.93	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.67	0.47	0.54	0.84	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.15	18.33	18.68	19.19	19.64	19.88	19.93	19.92	19.76	19.22	18.61	18.13	(90)

fLA = Living area ÷ (4) = 0.43 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.81	18.97	19.27	19.71	20.1	20.33	20.38	20.38	20.22	19.73	19.21	18.79	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.81	18.97	19.27	19.71	20.1	20.33	20.38	20.38	20.22	19.73	19.21	18.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.88	0.71	0.53	0.59	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	338.73	368.44	401.25	436.49	434.93	349.04	245.21	253.18	326.64	333.37	322.76	324.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	988.81	956.16	865.98	725.03	562.47	379.9	250.85	263.1	406.96	611.33	813.87	985.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	483.66	394.95	345.76	207.75	94.89	0	0	0	0	206.8	353.6	491.56	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2578.97 (98)

Space heating requirement in kWh/m²/year 45.95 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	483.66	394.95	345.76	207.75	94.89	0	0	0	0	206.8	353.6	491.56	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	517.84	422.86	370.19	222.43	101.59	0	0	0	0	221.41	378.59	526.29	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2761.21 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

172.31	150.52	156.6	138.9	134.48	118.44	113.48	126.5	127.9	145.63	155.46	168.26

Efficiency of water heater 80.3 (216)

(217)m=	87.51	87.37	86.99	86.06	84.19	80.3	80.3	80.3	80.3	85.93	87.06	87.59	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.9	172.28	180.03	161.39	159.73	147.5	141.31	157.53	159.27	169.47	178.58	192.1

Total = Sum(219a)$_{1...12}$ = 2016.1 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2761.21	
Water heating fuel used			2016.1	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			264.35	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	596.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	435.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1031.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	137.2	(268)
Total CO2, kg/year		sum of (265)…(271) =		1208.02	(272)

TER = 21.53 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:11

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 63.5m²

Site Reference : Lawnwood House **Plot Reference:** Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.43 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	22.37 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	60.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.50 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Heat pumps with radiators or underfloor heating - electric Air source heat pump with flow temperature <= 35°C
Secondary heating system:	None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	6.59m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93	
										Total = Sum(44)$_{1…12}$ =		1002.82	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02	
										Total = Sum(45)$_{1…12}$ =		1314.86	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	

Output from water heater (annual)$_{1...12}$ 2042.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.74	84.27	90.32	83.48	83.63	77.35	76.78	80.81	79.59	86.44	88.24	93.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	127.34	125.41	121.4	115.95	112.41	107.43	103.19	108.62	110.55	116.19	122.56	125.41	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	384.75	382.63	370.8	351.98	333.11	314.95	303.21	308.83	318.58	337.59	359.29	375.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	424.31	460.01	498.23	537.83	560.88	548.11	525.19	499.5	466.79	429.41	408.61	407.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.79	0.63	0.67	0.88	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.78	20.02	20.35	20.67	20.9	20.97	20.96	20.8	20.41	19.98	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.96	0.88	0.7	0.48	0.54	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.26	18.61	19.11	19.54	19.81	19.88	19.87	19.72	19.19	18.56	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	19.01	19.3	19.72	20.09	20.34	20.41	20.41	20.25	19.78	19.26	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.85	19.01	19.3	19.72	20.09	20.34	20.41	20.41	20.25	19.78	19.26	18.83	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.74	0.55	0.6	0.84	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.91	455.91	489.37	514.17	498.28	405.13	291.44	301.44	393.16	414.12	404.47	405.93	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1181.22	1142.28	1034.42	864.37	669.28	453.41	301.12	315.74	487.49	732.24	973.22	1176.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	564.93	461.24	405.52	252.15	127.22	0	0	0	0	236.68	409.5	573.35	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3030.58	(98)
Space heating requirement in kWh/m²/year	47.73	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	564.93	461.24	405.52	252.15	127.22	0	0	0	0	236.68	409.5	573.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	226.06	184.57	162.27	100.9	50.91	0	0	0	0	94.71	163.86	229.43		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1212.72	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)
Water heating														
Output from water heater (calculated above)	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	113.13	99.95	105.54	95.39	94.05	84.86	82.27	89.21	88.71	98.88	103.57	110.67		
Total = Sum(219a)$_{1...12}$ =													1166.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1212.72	
Water heating fuel used			1166.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	629.4	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

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Water heating	(219) x	0.519	=	605.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1234.68	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1420.33	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.37	(273)
EI rating (section 14)				82	(274)

Predicted Energy Assessment

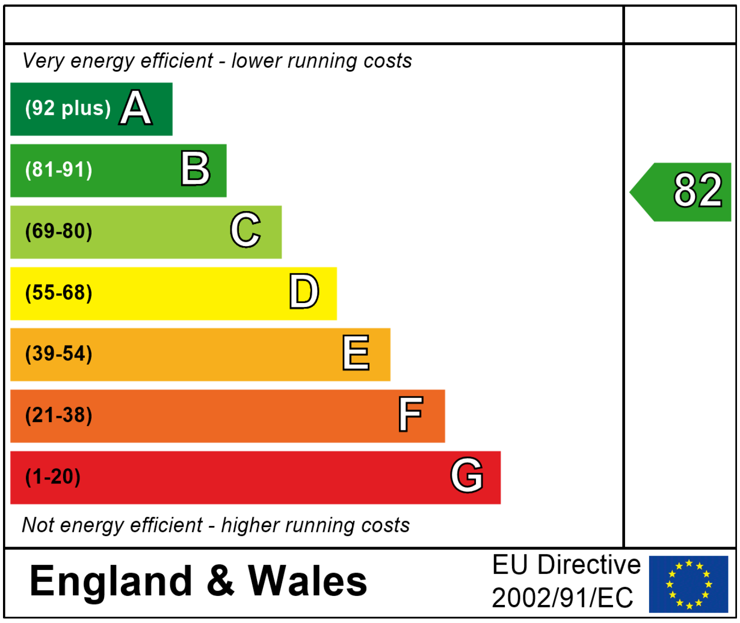
Flat 9
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	63.5 m²

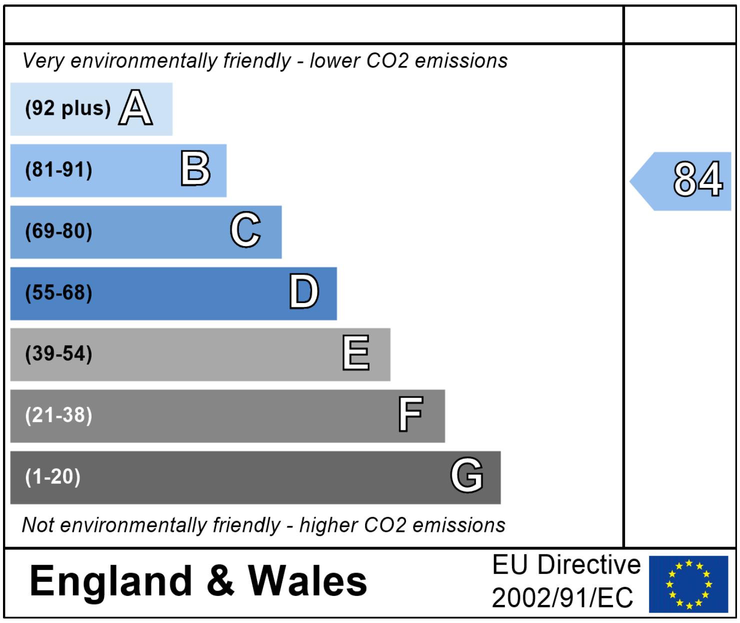
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)1…12 /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93	
										Total = Sum(44)1…12 =		1002.82	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02	
										Total = Sum(45)1…12 =		1314.86	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)
Water heating gains (Table 5)													
(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.95	0.86	0.71	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.52	19.65	19.89	20.24	20.58	20.84	20.95	20.93	20.72	20.29	19.85	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.63	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.64	18.89	19.24	19.57	19.8	19.87	19.87	19.71	19.29	18.85	18.5	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.98	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	332.25	368.02	405.69	440.1	442.31	377.43	282.91	288.68	346.02	336.81	317.8	316.66	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1193.95	1152.79	1040.75	865.43	666.9	451.16	300.25	314.47	484.03	731.97	980	1189.63	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	641.11	527.37	472.48	306.23	167.09	0	0	0	0	294	476.79	649.49	(98)

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = | 3534.55 | (98)

Space heating requirement in kWh/m²/year | 55.66 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	742.08	584.19	598.88	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.74	0.83	0.8	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	552.5	486.2	478.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	49.11	80.39	63.03	0	0	0	0	

Total = $Sum(104)_{6...8}$ = | 192.53 | (104)

Cooled fraction — f C = cooled area ÷ (4) = | 1 | (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = | 0 | (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	12.28	20.1	15.76	0	0	0	0

Total = $Sum(107)_{6...8}$ = | 48.13 | (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 0.76 | (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = | 56.42 | (109)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.85	0.69	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.72	19.96	20.3	20.62	20.87	20.96	20.95	20.76	20.34	19.91	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.55	0.61	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.63	18.75	18.99	19.34	19.65	19.87	19.92	19.92	19.78	19.38	18.95	18.62	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.68	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.28	368.05	405.68	439.69	440.22	371.45	274.87	281.53	343.65	336.68	317.83	316.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1145.53	1106	998.59	830.22	639.93	432.75	288.14	301.81	464.68	702.37	939.95	1140.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	605.06	495.9	441.13	281.18	148.59	0	0	0	0	272.07	447.93	613.19	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3305.05	(98)
Space heating requirement in kWh/m²/year	52.05	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	706.41	556.11	570.04	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.86	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	546.06	476.68	470.99	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	53.74	87.47	68.83	0	0	0	0

	Total = Sum(104)$_{6...8}$ =	210.04	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	13.43	21.87	17.21	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	52.51	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.83	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	52.87	(109)
Target Fabric Energy Efficiency (TFEE)		60.81	(109)

SAP WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	

Output from water heater (annual)$_{1...12}$ 2042.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.74	84.27	90.32	83.48	83.63	77.35	76.78	80.81	79.59	86.44	88.24	93.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	46.39	41.2	33.51	25.37	18.96	16.01	17.3	22.49	30.18	38.32	44.73	47.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.16	273.98	266.89	251.79	232.74	214.83	202.86	200.05	207.14	222.24	241.29	259.2	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	127.34	125.41	121.4	115.95	112.41	107.43	103.19	108.62	110.55	116.19	122.56	125.41	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	539.02	534.71	515.92	487.23	458.23	432.39	417.48	425.28	441.99	470.87	502.7	526.42	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	578.57	612.09	643.35	673.08	686	665.55	639.46	615.95	590.2	562.68	552.02	558.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.85	0.7	0.53	0.57	0.79	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	19.99	20.21	20.51	20.77	20.94	20.99	20.98	20.88	20.57	20.17	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.91	0.8	0.6	0.4	0.44	0.71	0.92	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.56	18.89	19.32	19.66	19.85	19.88	19.88	19.8	19.4	18.84	18.37	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.12	19.26	19.54	19.9	20.21	20.38	20.42	20.42	20.33	19.97	19.49	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.12	19.26	19.54	19.9	20.21	20.38	20.42	20.42	20.33	19.97	19.49	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.91	0.82	0.64	0.46	0.5	0.74	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	568.2	596.84	616.22	615.16	562.16	429.21	297.2	310.06	439.23	516.76	535.61	550.25	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1202.7	1163	1053.13	879.11	678.27	456.53	301.86	316.84	493.7	747.17	992.35	1197.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	472.07	380.47	325.06	190.04	86.39	0	0	0	0	171.43	328.85	481.62	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2435.93	(98)
Space heating requirement in kWh/m²/year	38.36	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	472.07	380.47	325.06	190.04	86.39	0	0	0	0	171.43	328.85	481.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	188.9	152.25	130.08	76.05	34.57	0	0	0	0	68.6	131.59	192.73		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													974.76	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	113.13	99.95	105.54	95.39	94.05	84.86	82.27	89.21	88.71	98.88	103.57	110.67		
Total = Sum(219a)$_{1...12}$ =													1166.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			974.76	
Water heating fuel used			1166.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			327.71	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	13.19	x 0.01 =	128.57	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)

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Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	153.83	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	43.23	(250)
Additional standing charges (Table 12)				0	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			329.58	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.2	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	505.9	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	605.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1111.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1296.83	(272)
CO2 emissions per m²		(272) ÷ (4) =		20.42	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2992.51	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3580.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6572.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	1006.08	(268)
'Total Primary Energy		sum of (265)…(271) =		7671.04	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		120.8	(273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1\ldots12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1\ldots12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1\ldots12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77	

Output from water heater (annual)$_{1...12}$ 1924.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.72	77.03	82.31	75.73	75.62	69.59	68.76	72.8	71.84	78.43	80.49	85.29	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	116.57	114.63	110.63	105.18	101.64	96.66	92.42	97.85	99.77	105.42	111.78	114.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	373.98	371.86	360.02	341.2	322.34	304.17	292.44	298.05	307.81	326.82	348.52	364.56	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	413.54	449.24	487.46	527.06	550.1	537.33	514.42	488.73	456.02	418.64	397.84	397.09	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.88	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.71	19.84	20.07	20.4	20.7	20.91	20.98	20.97	20.82	20.44	20.03	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.88	0.69	0.48	0.53	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.2	18.38	18.73	19.21	19.62	19.87	19.93	19.92	19.78	19.27	18.67	18.18	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.94	19.1	19.39	19.79	20.15	20.38	20.44	20.44	20.29	19.85	19.33	18.92	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.94	19.1	19.39	19.79	20.15	20.38	20.44	20.44	20.29	19.85	19.33	18.92	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.73	0.55	0.6	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	411.45	445.58	479.25	504.22	487.8	393.5	281.06	291.12	383.26	404.34	394.18	395.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.26	1095.83	992.32	828.84	641.69	434.43	288.74	302.72	467.37	702.1	933.16	1128.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	537.03	436.97	381.72	233.73	114.49	0	0	0	0	221.54	388.07	545.25	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2858.79 (98)

Space heating requirement in kWh/m²/year 45.02 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	537.03	436.97	381.72	233.73	114.49	0	0	0	0	221.54	388.07	545.25	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	574.36	467.34	408.26	249.98	122.45	0	0	0	0	236.94	415.05	583.15	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3057.53 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77	
Efficiency of water heater													79.8 (216)
(217)m=	87.46	87.28	86.84	85.87	84.03	79.8	79.8	79.8	79.8	85.63	86.93	87.54	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	215.04	190.16	201.26	183.24	184.07	174.05	167.98	183.19	182.51	190.49	197.47	209.92	

Total = Sum(219a)$_{1...12}$ = 2279.37 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3057.53	
Water heating fuel used			2279.37	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	660.43	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1152.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1361.78	(272)

TER =	31.43	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:30:50

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 63.5m²

Site Reference : Lawnwood House **Plot Reference:** Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	31.43 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.87 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	60.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.50 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Heat pumps with radiators or underfloor heating - electric
Air source heat pump with flow temperature <= 35°C

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.30 kWh/day	
	Permitted by DBSCG: 2.30 kWh/day	OK
Primary pipework insulated:	Yes	OK

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	Cylinderstat	**OK**
	Independent timer for DHW	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: East	6.59m²	
Ventilation rate:	2.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = $Sum(40)_{1...12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = $Sum(44)_{1...12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = $Sum(45)_{1...12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	

Output from water heater (annual)1…12 2042.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.74	84.27	90.32	83.48	83.63	77.35	76.78	80.81	79.59	86.44	88.24	93.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)
Water heating gains (Table 5)													
(72)m=	127.34	125.41	121.4	115.95	112.41	107.43	103.19	108.62	110.55	116.19	122.56	125.41	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	384.75	382.63	370.8	351.98	333.11	314.95	303.21	308.83	318.58	337.59	359.29	375.33	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	424.31	460.01	498.23	537.83	560.88	548.11	525.19	499.5	466.79	429.41	408.61	407.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.79	0.63	0.67	0.88	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.78	20.02	20.35	20.67	20.9	20.97	20.96	20.8	20.41	19.98	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.96	0.88	0.7	0.48	0.54	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.26	18.61	19.11	19.54	19.81	19.88	19.87	19.72	19.19	18.56	18.06	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.85	19.01	19.3	19.72	20.09	20.34	20.41	20.41	20.25	19.78	19.26	18.83	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.85	19.01	19.3	19.72	20.09	20.34	20.41	20.41	20.25	19.78	19.26	18.83	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.74	0.55	0.6	0.84	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.91	455.91	489.37	514.17	498.28	405.13	291.44	301.44	393.16	414.12	404.47	405.93	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1181.22	1142.28	1034.42	864.37	669.28	453.41	301.12	315.74	487.49	732.24	973.22	1176.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	564.93	461.24	405.52	252.15	127.22	0	0	0	0	236.68	409.5	573.35	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	3030.58	(98)
Space heating requirement in kWh/m²/year	47.73	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		249.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	564.93	461.24	405.52	252.15	127.22	0	0	0	0	236.68	409.5	573.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	226.06	184.57	162.27	100.9	50.91	0	0	0	0	94.71	163.86	229.43		(211)
Total (kWh/year) =$Sum(211)_{1...5,10...12}$=													1212.72	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =$Sum(215)_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	113.13	99.95	105.54	95.39	94.05	84.86	82.27	89.21	88.71	98.88	103.57	110.67		
Total = $Sum(219a)_{1...12}$ =													1166.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1212.72	
Water heating fuel used			1166.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			327.71	(232)
Electricity generated by PVs			-673.04	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	629.4	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	605.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1234.68	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-349.31	(269)
Total CO2, kg/year		sum of (265)…(271) =		1071.03	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.87	(273)
EI rating (section 14)				87	(274)

Predicted Energy Assessment

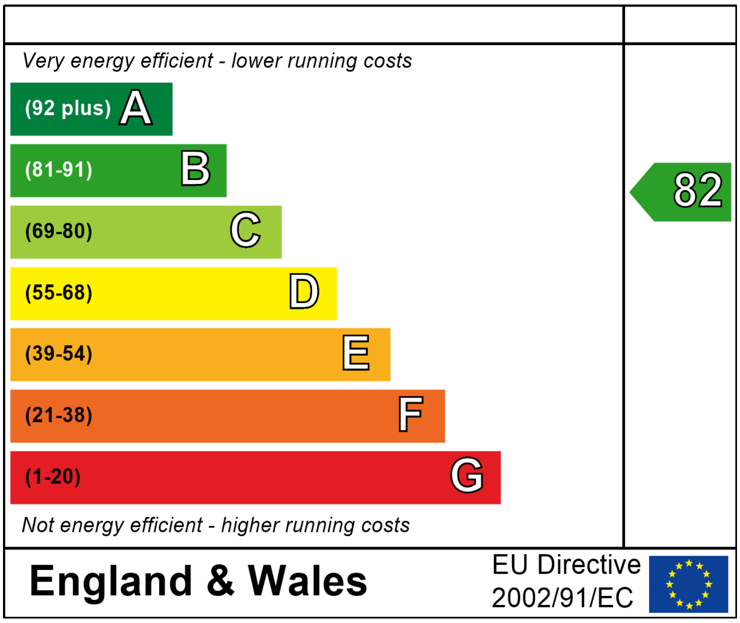
Flat 9
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	63.5 m²

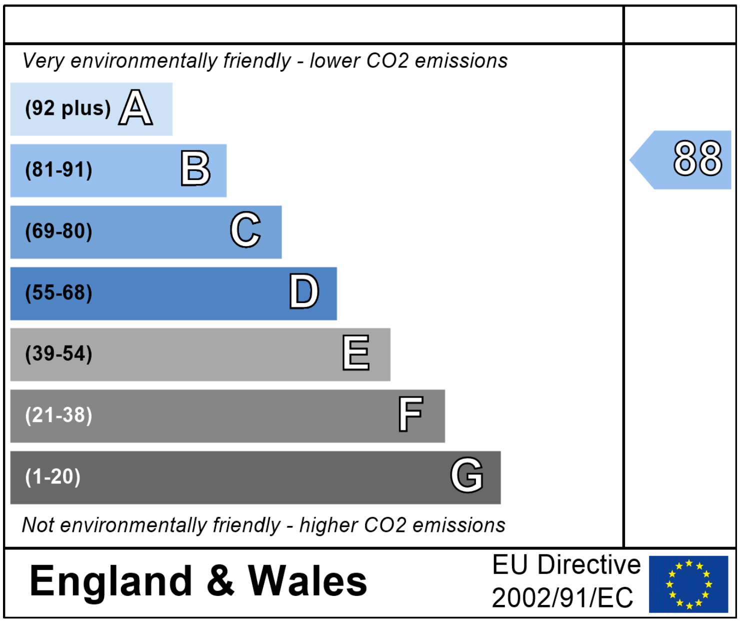
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K $(40)m = (39)m \div (4)$

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27	

Average = $Sum(40)_{1...12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = $Sum(44)_{1...12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = $Sum(45)_{1...12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.95	0.86	0.71	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.52	19.65	19.89	20.24	20.58	20.84	20.95	20.93	20.72	20.29	19.85	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.63	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.64	18.89	19.24	19.57	19.8	19.87	19.87	19.71	19.29	18.85	18.5	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.25	368.02	405.69	440.1	442.31	377.43	282.91	288.68	346.02	336.81	317.8	316.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1193.95	1152.79	1040.75	865.43	666.9	451.16	300.25	314.47	484.03	731.97	980	1189.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	641.11	527.37	472.48	306.23	167.09	0	0	0	0	294	476.79	649.49	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3534.55 (98)

Space heating requirement in kWh/m²/year 55.66 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	742.08	584.19	598.88	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.74	0.83	0.8	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	552.5	486.2	478.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	49.11	80.39	63.03	0	0	0	0	
Intermittency factor (Table 10b)													
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	
Space cooling requirement for month = (104)m × (105) × (106)m													
(107)m=	0	0	0	0	0	12.28	20.1	15.76	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 192.53 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Total = Sum(104)$_{6...8}$ = 0 (106)

Total = Sum(107)$_{6...8}$ = 48.13 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.76 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.42 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)
Water heating gains (Table 5)													
(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.85	0.69	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.72	19.96	20.3	20.62	20.87	20.96	20.95	20.76	20.34	19.91	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.55	0.61	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.63	18.75	18.99	19.34	19.65	19.87	19.92	19.92	19.78	19.38	18.95	18.62	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.68	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.28	368.05	405.68	439.69	440.22	371.45	274.87	281.53	343.65	336.68	317.83	316.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1145.53	1106	998.59	830.22	639.93	432.75	288.14	301.81	464.68	702.37	939.95	1140.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	605.06	495.9	441.13	281.18	148.59	0	0	0	0	272.07	447.93	613.19	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3305.05 | (98)

Space heating requirement in kWh/m²/year | 52.05 | (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	706.41	556.11	570.04	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.86	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	546.06	476.68	470.99	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.74	87.47	68.83	0	0	0	0	

Total = Sum(104)$_{6...8}$ = | 210.04 | (104)

Cooled fraction — f C = cooled area ÷ (4) = | 1 | (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = | 0 | (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	13.43	21.87	17.21	0	0	0	0

Total = Sum(107)$_{6...8}$ = | 52.51 | (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = | 0.83 | (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = | 52.87 | (109)

Target Fabric Energy Efficiency (TFEE) | 60.81 | (109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.3 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.24 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.24 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	38.5	34.78	38.5	37.26	38.5	37.26	38.5	38.5	37.26	38.5	37.26	38.5	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79	

Output from water heater (annual)$_{1...12}$ 2042.08 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	94.74	84.27	90.32	83.48	83.63	77.35	76.78	80.81	79.59	86.44	88.24	93.31	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	46.39	41.2	33.51	25.37	18.96	16.01	17.3	22.49	30.18	38.32	44.73	47.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.16	273.98	266.89	251.79	232.74	214.83	202.86	200.05	207.14	222.24	241.29	259.2	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	127.34	125.41	121.4	115.95	112.41	107.43	103.19	108.62	110.55	116.19	122.56	125.41	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	539.02	534.71	515.92	487.23	458.23	432.39	417.48	425.28	441.99	470.87	502.7	526.42	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	578.57	612.09	643.35	673.08	686	665.55	639.46	615.95	590.2	562.68	552.02	558.95	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.94	0.85	0.7	0.53	0.57	0.79	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	19.99	20.21	20.51	20.77	20.94	20.99	20.98	20.88	20.57	20.17	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.91	0.8	0.6	0.4	0.44	0.71	0.92	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.39	18.56	18.89	19.32	19.66	19.85	19.88	19.88	19.8	19.4	18.84	18.37	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.12	19.26	19.54	19.9	20.21	20.38	20.42	20.42	20.33	19.97	19.49	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.12	19.26	19.54	19.9	20.21	20.38	20.42	20.42	20.33	19.97	19.49	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.91	0.82	0.64	0.46	0.5	0.74	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	568.2	596.84	616.22	615.16	562.16	429.21	297.2	310.06	439.23	516.76	535.61	550.25	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1202.7	1163	1053.13	879.11	678.27	456.53	301.86	316.84	493.7	747.17	992.35	1197.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	472.07	380.47	325.06	190.04	86.39	0	0	0	0	171.43	328.85	481.62	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2435.93 (98)

Space heating requirement in kWh/m²/year 38.36 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 249.9 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	472.07	380.47	325.06	190.04	86.39	0	0	0	0	171.43	328.85	481.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	188.9	152.25	130.08	76.05	34.57	0	0	0	0	68.6	131.59	192.73		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													974.76	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	198.09	175.02	184.8	167.04	164.69	148.59	144.06	156.2	155.34	173.14	181.35	193.79		
Efficiency of water heater													175.1	(216)
(217)m=	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	113.13	99.95	105.54	95.39	94.05	84.86	82.27	89.21	88.71	98.88	103.57	110.67		
Total = Sum(219a)$_{1...12}$ =													1166.24	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			974.76	
Water heating fuel used			1166.24	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			327.71	(232)
Electricity generated by PVs			-673.04	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	128.57	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	153.83	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.23	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	329.58	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.28	(257)
SAP rating (Section 12)		82.2	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	505.9	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	605.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1111.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Energy saving/generation technologies Item 1		0.519	=	-349.31	(269)
Total CO2, kg/year		sum of (265)…(271) =		947.53	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.92	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2992.51	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	3580.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6572.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)

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Electricity for lighting	(232) x	0	=	1006.08 (268)
Energy saving/generation technologies				
Item 1		3.07	=	-2066.22 (269)
'Total Primary Energy		sum of (265)…(271) =		5604.82 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		88.26 (273)

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User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - ASHP + PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.7 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.92 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.92 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77	

Output from water heater (annual)$_{1...12}$ 1924.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	86.72	77.03	82.31	75.73	75.62	69.59	68.76	72.8	71.84	78.43	80.49	85.29	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	116.57	114.63	110.63	105.18	101.64	96.66	92.42	97.85	99.77	105.42	111.78	114.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	373.98	371.86	360.02	341.2	322.34	304.17	292.44	298.05	307.81	326.82	348.52	364.56	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	413.54	449.24	487.46	527.06	550.1	537.33	514.42	488.73	456.02	418.64	397.84	397.09	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.88	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.71	19.84	20.07	20.4	20.7	20.91	20.98	20.97	20.82	20.44	20.03	19.7	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.88	0.69	0.48	0.53	0.82	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.2	18.38	18.73	19.21	19.62	19.87	19.93	19.92	19.78	19.27	18.67	18.18	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.94	19.1	19.39	19.79	20.15	20.38	20.44	20.44	20.29	19.85	19.33	18.92	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.94	19.1	19.39	19.79	20.15	20.38	20.44	20.44	20.29	19.85	19.33	18.92	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.73	0.55	0.6	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	411.45	445.58	479.25	504.22	487.8	393.5	281.06	291.12	383.26	404.34	394.18	395.44	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.26	1095.83	992.32	828.84	641.69	434.43	288.74	302.72	467.37	702.1	933.16	1128.29	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	537.03	436.97	381.72	233.73	114.49	0	0	0	0	221.54	388.07	545.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2858.79	(98)
Space heating requirement in kWh/m²/year	45.02	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	537.03	436.97	381.72	233.73	114.49	0	0	0	0	221.54	388.07	545.25		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	574.36	467.34	408.26	249.98	122.45	0	0	0	0	236.94	415.05	583.15		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3057.53	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	188.07	165.97	174.78	157.34	154.67	138.89	134.05	146.19	145.64	163.12	171.65	183.77		
Efficiency of water heater													79.8	(216)
(217)m=	87.46	87.28	86.84	85.87	84.03	79.8	79.8	79.8	79.8	85.63	86.93	87.54		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	215.04	190.16	201.26	183.24	184.07	174.05	167.98	183.19	182.51	190.49	197.47	209.92		
Total = Sum(219a)$_{1...12}$ =													2279.37	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3057.53	
Water heating fuel used			2279.37	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	660.43	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1152.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1361.78	(272)

TER =	31.43	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:20

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 63.5m²

Site Reference : Lawnwood House **Plot Reference:** Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	21.64 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	21.14 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	60.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.4 kWh/m²	
		OK

2 Fabric U-values

Element	**Average**	**Highest**	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	**OK**
Openings	1.50 (max. 2.00)	1.80 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: East	6.59m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	30.44	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6281.55	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		21.62	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	52.06	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.16	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	

Output from water heater (annual)$_{1…12}$ 1485.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.98	42.93	44.54	39.17	37.84	33.02	30.97	35.01	35.27	40.66	43.94	47.54	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	65.83	63.89	59.87	54.4	50.86	45.86	41.62	47.06	48.99	54.65	61.03	63.9	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.24	321.12	309.27	290.43	271.55	253.38	241.64	247.26	257.03	276.05	297.77	313.82	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	362.8	398.49	436.7	476.28	499.32	486.54	463.62	437.94	405.24	367.87	347.09	346.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.84	0.69	0.74	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.69	19.93	20.28	20.61	20.86	20.96	20.94	20.75	20.32	19.89	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.91	0.76	0.54	0.6	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.95	18.14	18.49	19	19.46	19.78	19.87	19.86	19.66	19.07	18.43	17.93	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.9	19.2	19.62	20.02	20.31	20.4	20.39	20.19	19.69	19.15	18.72	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.59	18.75	19.05	19.47	19.87	20.16	20.25	20.24	20.04	19.54	19	18.57	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.78	0.6	0.65	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	361.64	396.35	431.66	461.49	456.36	379.66	276.1	284.27	356.88	359.65	345.11	345.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1160.25	1121.44	1013.87	844.8	651.63	438.98	288.52	302.81	471.01	712.43	952.62	1155.75	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	594.16	487.26	433.17	275.98	145.28	0	0	0	0	262.47	437.41	602.86	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3238.59	(98)
Space heating requirement in kWh/m²/year	51	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	594.16	487.26	433.17	275.98	145.28	0	0	0	0	262.47	437.41	602.86		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	656.54	538.41	478.64	304.95	160.53	0	0	0	0	290.02	483.32	666.15		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3578.55	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.83	89.8	89.71	89.5	89.04	87.3	87.3	87.3	87.3	89.44	89.72	89.86		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	168	147.43	153.35	135.52	131.83	117.72	110.77	124.72	125.5	140.74	151.2	163.15		
Total = Sum(219a)$_{1...12}$ =													1669.91	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3578.55	
Water heating fuel used			1669.91	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	772.97	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	360.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1133.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1342.68	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.14	(273)
EI rating (section 14)				83	(274)

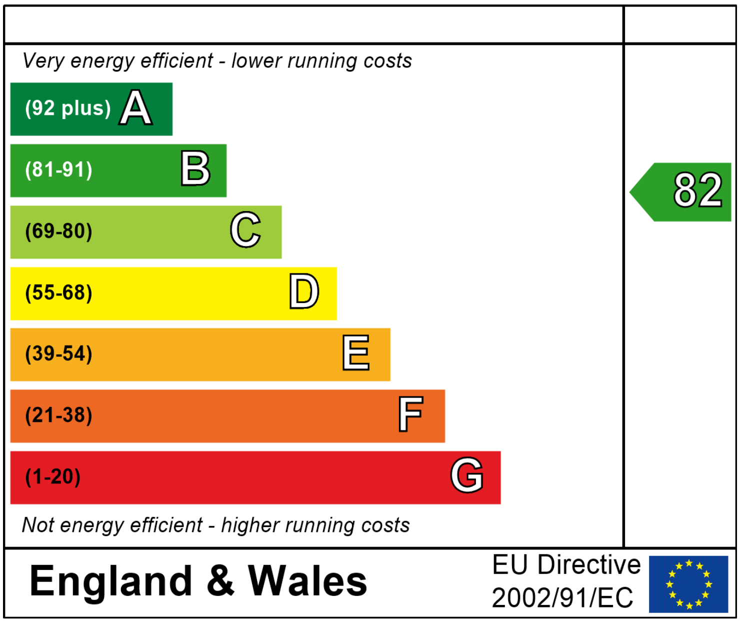
Predicted Energy Assessment

Flat 9	Dwelling type:	Top floor Flat
Lawnwood House, Lawnwood Road Industrial Estate	Date of assessment:	20 April 2020
Lawnwood Road	Produced by:	Benjamin Leech
Bristol	Total floor area:	63.5 m²
BS5 0EF		

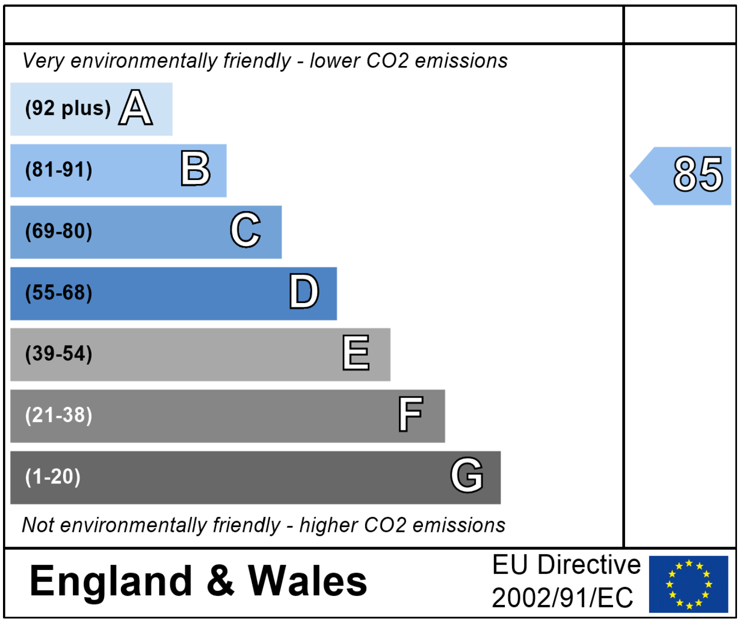
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93	
Total = Sum(44)$_{1…12}$ = 1002.82													(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02	
Total = Sum(45)$_{1…12}$ = 1314.86													(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.95	0.86	0.71	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.52	19.65	19.89	20.24	20.58	20.84	20.95	20.93	20.72	20.29	19.85	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.63	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.64	18.89	19.24	19.57	19.8	19.87	19.87	19.71	19.29	18.85	18.5	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.25	368.02	405.69	440.1	442.31	377.43	282.91	288.68	346.02	336.81	317.8	316.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1193.95	1152.79	1040.75	865.43	666.9	451.16	300.25	314.47	484.03	731.97	980	1189.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	641.11	527.37	472.48	306.23	167.09	0	0	0	0	294	476.79	649.49	

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Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3534.55 (98)

Space heating requirement in kWh/m²/year 55.66 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	742.08	584.19	598.88	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.74	0.83	0.8	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	552.5	486.2	478.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	49.11	80.39	63.03	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 192.53 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $Sum(104)_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	12.28	20.1	15.76	0	0	0	0

Total = $Sum(107)_{6...8}$ = 48.13 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.76 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.42 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21	

Average = Sum(40)$_{1…12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.85	0.69	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.72	19.96	20.3	20.62	20.87	20.96	20.95	20.76	20.34	19.91	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.55	0.61	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.63	18.75	18.99	19.34	19.65	19.87	19.92	19.92	19.78	19.38	18.95	18.62	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.68	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.28	368.05	405.68	439.69	440.22	371.45	274.87	281.53	343.65	336.68	317.83	316.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1145.53	1106	998.59	830.22	639.93	432.75	288.14	301.81	464.68	702.37	939.95	1140.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	605.06	495.9	441.13	281.18	148.59	0	0	0	0	272.07	447.93	613.19	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3305.05	(98)
Space heating requirement in kWh/m²/year	52.05	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	706.41	556.11	570.04	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.86	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	546.06	476.68	470.99	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.74	87.47	68.83	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	210.04	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	13.43	21.87	17.21	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	52.51	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.83	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	52.87	(109)
Target Fabric Energy Efficiency (TFEE)		60.81	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27	

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93	

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02	

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.16	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	

Output from water heater (annual)$_{1...12}$ 1485.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.98	42.93	44.54	39.17	37.84	33.02	30.97	35.01	35.27	40.66	43.94	47.54	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	46.39	41.2	33.51	25.37	18.96	16.01	17.3	22.49	30.18	38.32	44.73	47.68	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	271.16	273.98	266.89	251.79	232.74	214.83	202.86	200.05	207.14	222.24	241.29	259.2	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)
Water heating gains (Table 5)													
(72)m=	65.83	63.89	59.87	54.4	50.86	45.86	41.62	47.06	48.99	54.65	61.03	63.9	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	477.51	473.19	454.39	425.69	396.68	370.82	355.91	363.72	380.44	409.33	441.17	464.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	517.06	550.57	581.82	611.54	624.45	603.98	577.88	554.39	528.64	501.14	490.49	497.43	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.74	0.58	0.62	0.84	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.78	19.9	20.13	20.44	20.73	20.92	20.98	20.97	20.85	20.5	20.09	19.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.94	0.84	0.65	0.44	0.49	0.76	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.27	18.44	18.77	19.23	19.61	19.83	19.88	19.88	19.76	19.31	18.72	18.24	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.16	19.44	19.82	20.16	20.37	20.42	20.41	20.3	19.89	19.39	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.86	19.01	19.29	19.67	20.01	20.22	20.27	20.26	20.15	19.74	19.24	18.84	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.93	0.85	0.68	0.49	0.53	0.78	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	510.63	540.7	563.39	569.79	529.23	410.32	284.05	296.21	413.41	470.43	480.35	492.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1182.08	1142.64	1033.32	860.78	662.3	443.29	289.7	304.55	479.15	728.72	972.32	1177.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	499.56	404.5	349.62	209.51	99	0	0	0	0	192.17	354.22	509.56	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2618.15	(98)
Space heating requirement in kWh/m²/year	41.23	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	499.56	404.5	349.62	209.51	99	0	0	0	0	192.17	354.22	509.56		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	552	446.96	386.32	231.51	109.4	0	0	0	0	212.34	391.41	563.05		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2892.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.74	89.69	89.57	89.3	88.74	87.3	87.3	87.3	87.3	89.21	89.59	89.76		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	168.18	147.61	153.58	135.82	132.28	117.72	110.77	124.72	125.5	141.11	151.42	163.32		
Total = Sum(219a)$_{1...12}$ =													1672.01	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2892.98	
Water heating fuel used			1672.01	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	100.68	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	58.19	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.23	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	331.98	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		82.07	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	624.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	361.15	(264)
Space and water heating	(261) + (262) + (263) + (264) =			986.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1195.05	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.82	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3529.44	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2039.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5569.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1006.08	(268)
'Total Primary Energy		sum of (265)…(271) =		6805.62	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		107.18	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - Baseline

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1...12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1...12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1...12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.84	40.77	43.44	40.39	40.03	37.09	38.33	40.03	40.39	43.44	43.68	46.84	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87	

Output from water heater (annual)$_{1...12}$ 1816.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	57.04	49.84	51.77	45.76	44.23	38.8	36.95	41.41	41.87	47.89	51.34	55.61	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	76.66	74.16	69.58	63.56	59.45	53.89	49.66	55.66	58.16	64.37	71.31	74.74	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	334.08	331.39	318.98	299.59	280.15	261.41	249.68	255.86	266.19	285.78	308.05	324.66	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	373.64	408.77	446.41	485.44	507.91	494.57	471.65	446.54	414.4	377.59	357.37	357.19	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.71	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.66	19.78	20.02	20.35	20.66	20.89	20.97	20.96	20.79	20.39	19.97	19.64	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.57	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.12	18.3	18.65	19.13	19.57	19.85	19.92	19.92	19.74	19.2	18.58	18.1	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.03	19.32	19.73	20.1	20.36	20.44	20.43	20.26	19.78	19.26	18.85	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.87	19.03	19.32	19.73	20.1	20.36	20.44	20.43	20.26	19.78	19.26	18.85	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.77	0.59	0.64	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.39	406.48	441.01	469.5	461.72	381.4	277.77	286.25	362.24	368.62	355.22	356.23	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.77	1090.32	986.92	823.96	638.1	432.9	288.33	302.12	464.58	697.1	927.73	1122.83	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	562	459.55	406.16	255.21	131.23	0	0	0	0	244.39	412.21	570.35	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3041.09	(98)
Space heating requirement in kWh/m²/year	47.89	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	562	459.55	406.16	255.21	131.23	0	0	0	0	244.39	412.21	570.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	601.72	492.02	434.86	273.24	140.5	0	0	0	0	261.66	441.33	610.65		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3255.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87		
Efficiency of water heater													80.3	(216)
(217)m=	87.69	87.56	87.21	86.42	84.84	80.3	80.3	80.3	80.3	86.2	87.26	87.76		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	208.88	182.74	190.88	170.86	168.5	156.79	150.22	167.46	169.31	179.6	189.39	203.8		
Total = Sum(219a)$_{1...12}$ =													2138.44	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3255.98	
Water heating fuel used			2138.44	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	703.29	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	461.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1165.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1374.2	(272)

TER =	21.64	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.25
Printed on 21 April 2020 at 15:31:00

Project Information:

Assessed By: Benjamin Leech (STRO033391) **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 63.5m²

Site Reference : Lawnwood House **Plot Reference:** Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas		
Fuel factor: 1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	21.64 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	17.11 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	60.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	56.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.50 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 459, product index 017956): Boiler systems with radiators or underfloor heating - mains gas Brand name: Ideal Model: LOGIC COMBI Model qualifier: ESP1 30 (Combi) Efficiency 89.6 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Severn valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: East	6.59m²
Ventilation rate:	2.00
Blinds/curtains:	Dark-coloured curtain or roller blind
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = $Sum(39)_{1\ldots12}$ /12= 79.89 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	14.59	13.16	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	

Output from water heater (annual)$_{1...12}$ 1485.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.98	42.93	44.54	39.17	37.84	33.02	30.97	35.01	35.27	40.66	43.94	47.54	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	65.83	63.89	59.87	54.4	50.86	45.86	41.62	47.06	48.99	54.65	61.03	63.9	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.24	321.12	309.27	290.43	271.55	253.38	241.64	247.26	257.03	276.05	297.77	313.82	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	362.8	398.49	436.7	476.28	499.32	486.54	463.62	437.94	405.24	367.87	347.09	346.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.84	0.69	0.74	0.92	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.69	19.93	20.28	20.61	20.86	20.96	20.94	20.75	20.32	19.89	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.91	0.76	0.54	0.6	0.87	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.95	18.14	18.49	19	19.46	19.78	19.87	19.86	19.66	19.07	18.43	17.93	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.9	19.2	19.62	20.02	20.31	20.4	20.39	20.19	19.69	19.15	18.72	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.59	18.75	19.05	19.47	19.87	20.16	20.25	20.24	20.04	19.54	19	18.57	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.78	0.6	0.65	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	361.64	396.35	431.66	461.49	456.36	379.66	276.1	284.27	356.88	359.65	345.11	345.46	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1160.25	1121.44	1013.87	844.8	651.63	438.98	288.52	302.81	471.01	712.43	952.62	1155.75	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	594.16	487.26	433.17	275.98	145.28	0	0	0	0	262.47	437.41	602.86	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3238.59	(98)
Space heating requirement in kWh/m²/year	51	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	594.16	487.26	433.17	275.98	145.28	0	0	0	0	262.47	437.41	602.86		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	656.54	538.41	478.64	304.95	160.53	0	0	0	0	290.02	483.32	666.15		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3578.55	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.83	89.8	89.71	89.5	89.04	87.3	87.3	87.3	87.3	89.44	89.72	89.86		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	168	147.43	153.35	135.52	131.83	117.72	110.77	124.72	125.5	140.74	151.2	163.15		
Total = Sum(219a)$_{1...12}$ =													1669.91	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3578.55	
Water heating fuel used			1669.91	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)
Electricity generated by PVs			-493.56	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	772.97	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	360.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1133.67	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Energy saving/generation technologies Item 1		0.519	=	-256.16	(269)
Total CO2, kg/year	sum of (265)…(271) =			1086.52	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.11	(273)
EI rating (section 14)				87	(274)

Predicted Energy Assessment

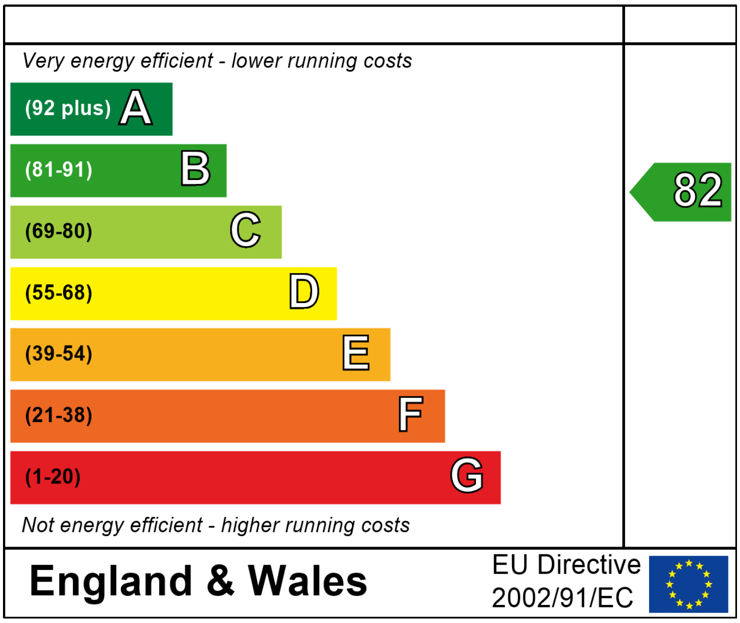
Flat 9
Lawnwood House, Lawnwood Road Industrial Estate
Lawnwood Road
Bristol
BS5 0EF

Dwelling type:	Top floor Flat
Date of assessment:	20 April 2020
Produced by:	Benjamin Leech
Total floor area:	63.5 m²

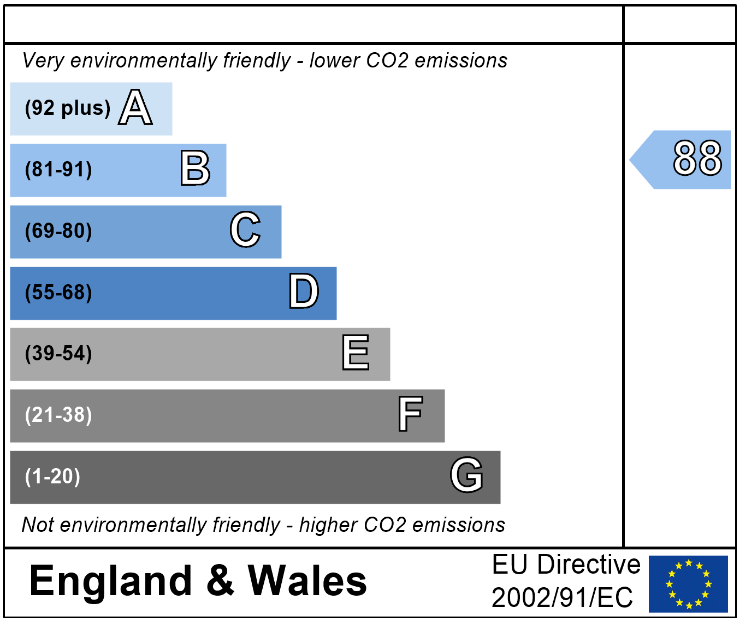
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.5	(1a) x	2.3	(2a) =	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DFEE WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = Sum(40)$_{1…12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1…12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1…12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.95	0.86	0.71	0.77	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.52	19.65	19.89	20.24	20.58	20.84	20.95	20.93	20.72	20.29	19.85	19.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.78	0.57	0.63	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.64	18.89	19.24	19.57	19.8	19.87	19.87	19.71	19.29	18.85	18.5	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.14	19.38	19.73	20.06	20.31	20.4	20.39	20.21	19.78	19.34	18.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.7	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.25	368.02	405.69	440.1	442.31	377.43	282.91	288.68	346.02	336.81	317.8	316.66	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1193.95	1152.79	1040.75	865.43	666.9	451.16	300.25	314.47	484.03	731.97	980	1189.63	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	641.11	527.37	472.48	306.23	167.09	0	0	0	0	294	476.79	649.49	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3534.55 (98)

Space heating requirement in kWh/m²/year 55.66 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	742.08	584.19	598.88	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.74	0.83	0.8	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	552.5	486.2	478.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	49.11	80.39	63.03	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 192.53 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	12.28	20.1	15.76	0	0	0	0

Total = Sum(107)$_{6...8}$ = 48.13 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.76 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 56.42 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1...12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1...12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1...12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	115.87	101.34	104.58	91.17	87.48	75.49	69.95	80.27	81.23	94.67	103.34	112.22	

Output from water heater (annual)$_{1...12}$ 1117.63 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	28.97	25.34	26.14	22.79	21.87	18.87	17.49	20.07	20.31	23.67	25.83	28.05	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	38.94	37.7	35.14	31.66	29.4	26.21	23.51	26.97	28.21	31.81	35.88	37.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	293.35	291.93	281.54	264.69	247.1	230.73	220.52	224.18	233.24	250.22	269.62	284.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	332.91	369.31	408.97	450.54	474.86	463.89	442.5	414.86	381.45	342.03	318.94	317.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.85	0.69	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.72	19.96	20.3	20.62	20.87	20.96	20.95	20.76	20.34	19.91	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.55	0.61	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.63	18.75	18.99	19.34	19.65	19.87	19.92	19.92	19.78	19.38	18.95	18.62	(90)

fLA = Living area ÷ (4) = | 0.49 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.23	19.47	19.81	20.13	20.36	20.43	20.42	20.26	19.85	19.42	19.09	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.93	0.8	0.62	0.68	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.28	368.05	405.68	439.69	440.22	371.45	274.87	281.53	343.65	336.68	317.83	316.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1145.53	1106	998.59	830.22	639.93	432.75	288.14	301.81	464.68	702.37	939.95	1140.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	605.06	495.9	441.13	281.18	148.59	0	0	0	0	272.07	447.93	613.19	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3305.05 (98)
Space heating requirement in kWh/m²/year	52.05 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	706.41	556.11	570.04	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.77	0.86	0.83	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	546.06	476.68	470.99	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	620.7	594.25	563.5	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	53.74	87.47	68.83	0	0	0	0	

	Total = Sum(104)$_{6...8}$ =	210.04	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	13.43	21.87	17.21	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	52.51	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.83	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	52.87	(109)
Target Fabric Energy Efficiency (TFEE)		60.81	(109)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1.8	=	3.96			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 21.62 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.06 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.18	80.98	80.79	79.89	79.73	78.94	78.94	78.8	79.25	79.73	80.07	80.42	

Average = Sum(39)$_{1…12}$ /12= 79.89 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.28	1.28	1.27	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27

Average = $Sum(40)_{1...12}$ /12= 1.26 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93	
Total = $Sum(44)_{1...12}$ =												1002.82	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02	
Total = $Sum(45)_{1...12}$ =												1314.86	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year — (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	14.59	13.16	14.53	14.02	14.46	13.96	14.4	14.44	13.99	14.5	14.08	14.58	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6	

Output from water heater (annual)$_{1...12}$ 1485.58 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	48.98	42.93	44.54	39.17	37.84	33.02	30.97	35.01	35.27	40.66	43.94	47.54	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	124.72	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	46.39	41.2	33.51	25.37	18.96	16.01	17.3	22.49	30.18	38.32	44.73	47.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.16	273.98	266.89	251.79	232.74	214.83	202.86	200.05	207.14	222.24	241.29	259.2	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	49.55	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	65.83	63.89	59.87	54.4	50.86	45.86	41.62	47.06	48.99	54.65	61.03	63.9	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	477.51	473.19	454.39	425.69	396.68	370.82	355.91	363.72	380.44	409.33	441.17	464.91	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

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East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	517.06	550.57	581.82	611.54	624.45	603.98	577.88	554.39	528.64	501.14	490.49	497.43	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.74	0.58	0.62	0.84	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.78	19.9	20.13	20.44	20.73	20.92	20.98	20.97	20.85	20.5	20.09	19.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.94	0.84	0.65	0.44	0.49	0.76	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.27	18.44	18.77	19.23	19.61	19.83	19.88	19.88	19.76	19.31	18.72	18.24	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.01	19.16	19.44	19.82	20.16	20.37	20.42	20.41	20.3	19.89	19.39	18.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.86	19.01	19.29	19.67	20.01	20.22	20.27	20.26	20.15	19.74	19.24	18.84	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.93	0.85	0.68	0.49	0.53	0.78	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	510.63	540.7	563.39	569.79	529.23	410.32	284.05	296.21	413.41	470.43	480.35	492.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1182.08	1142.64	1033.32	860.78	662.3	443.29	289.7	304.55	479.15	728.72	972.32	1177.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	499.56	404.5	349.62	209.51	99	0	0	0	0	192.17	354.22	509.56	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2618.15 (98)
Space heating requirement in kWh/m²/year	41.23 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	499.56	404.5	349.62	209.51	99	0	0	0	0	192.17	354.22	509.56		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	552	446.96	386.32	231.51	109.4	0	0	0	0	212.34	391.41	563.05		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2892.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)
Water heating														
Output from water heater (calculated above)	150.92	132.39	137.56	121.29	117.38	102.77	96.7	108.88	109.56	125.88	135.65	146.6		
Efficiency of water heater													87.3	(216)
(217)m=	89.74	89.69	89.57	89.3	88.74	87.3	87.3	87.3	87.3	89.21	89.59	89.76		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	168.18	147.61	153.58	135.82	132.28	117.72	110.77	124.72	125.5	141.11	151.42	163.32		
Total = Sum(219a)$_{1...12}$ =													1672.01	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2892.98	
Water heating fuel used			1672.01	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)
Electricity generated by PVs			-493.56	(233)

10a. Fuel costs - individual heating systems:

Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

Space heating - main system 1	(211) x	3.48	x 0.01 =	100.68 (240)
Space heating - main system 2	(213) x	0	x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	58.19 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89 (249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.23 (250)
Additional standing charges (Table 12)				120 (251)
	one of (233) to (235) x)	13.19	x 0.01 =	0 (252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	331.98 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29 (257)
SAP rating (Section 12)		82.07 (258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	624.88 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	361.15 (264)
Space and water heating	(261) + (262) + (263) + (264) =			986.04 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	170.08 (268)
Energy saving/generation technologies Item 1		0.519	=	-256.16 (269)
Total CO2, kg/year		sum of (265)…(271) =		938.89 (272)
CO2 emissions per m²		(272) ÷ (4) =		14.79 (273)
EI rating (section 14)				88 (274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year
Space heating (main system 1)	(211) x	1.22	=	3529.44 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	1.22	=	2039.85 (264)
Space and water heating	(261) + (262) + (263) + (264) =			5569.29 (265)

Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	1006.08	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1515.23	(269)
'Total Primary Energy			sum of (265)…(271) =		5290.39	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		83.31	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Benjamin Leech	**Stroma Number:**	STRO033391
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: Flat 9 - PV

Address : Flat 9, Lawnwood House, Lawnwood Road Industrial Estate, Lawnwood Road, Bristol, BS5 0EF

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.5	(1a)	x	2.3	(2a)	=	146.05	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.5	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			146.05	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows			6.59	x1/[1/(1.4)+ 0.04]		=	8.74			(27)
Walls	61.49	8.79	52.7	x	0.18	=	9.49			(29)
Roof	63.5	0	63.5	x	0.13	=	8.25			(30)
Total area of elements, m²			124.99							(31)
Party wall			14.29	x	0	=	0			(32)
Party floor			63.5							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 28.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6281.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.59 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.27 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.12	28.92	28.73	27.83	27.67	26.88	26.88	26.74	27.19	27.67	28.01	28.36	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	77.38	77.19	77	76.1	75.93	75.15	75.15	75.01	75.45	75.93	76.27	76.63	

Average = Sum(39)$_{1…12}$ /12= 76.1 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.22	1.21	1.2	1.2	1.18	1.18	1.18	1.19	1.2	1.2	1.21

Average = Sum(40)$_{1\ldots12}$ /12= 1.2 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.08 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.57 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.93	88.58	85.24	81.9	78.55	75.21	75.21	78.55	81.9	85.24	88.58	91.93

Total = Sum(44)$_{1\ldots12}$ = 1002.82 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.32	119.23	123.03	107.26	102.92	88.81	82.3	94.44	95.57	111.37	121.57	132.02

Total = Sum(45)$_{1\ldots12}$ = 1314.86 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.88	18.45	16.09	15.44	13.32	12.34	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.84	40.77	43.44	40.39	40.03	37.09	38.33	40.03	40.39	43.44	43.68	46.84	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87	

Output from water heater (annual)$_{1...12}$ 1816.13 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	57.04	49.84	51.77	45.76	44.23	38.8	36.95	41.41	41.87	47.89	51.34	55.61	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	103.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.56	16.48	13.4	10.15	7.59	6.4	6.92	8.99	12.07	15.33	17.89	19.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	181.68	183.57	178.81	168.7	155.93	143.93	135.92	134.03	138.78	148.9	161.66	173.66	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	33.39	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	-83.15	(71)

Water heating gains (Table 5)

(72)m=	76.66	74.16	69.58	63.56	59.45	53.89	49.66	55.66	58.16	64.37	71.31	74.74	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	334.08	331.39	318.98	299.59	280.15	261.41	249.68	255.86	266.19	285.78	308.05	324.66	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.59	x	19.64	x	0.63	x	0.7	=	39.56	(76)
East	0.9x	0.77	x	6.59	x	38.42	x	0.63	x	0.7	=	77.38	(76)
East	0.9x	0.77	x	6.59	x	63.27	x	0.63	x	0.7	=	127.43	(76)
East	0.9x	0.77	x	6.59	x	92.28	x	0.63	x	0.7	=	185.85	(76)
East	0.9x	0.77	x	6.59	x	113.09	x	0.63	x	0.7	=	227.77	(76)

East	0.9x	0.77	x	6.59	x	115.77	x	0.63	x	0.7	=	233.16	(76)
East	0.9x	0.77	x	6.59	x	110.22	x	0.63	x	0.7	=	221.98	(76)
East	0.9x	0.77	x	6.59	x	94.68	x	0.63	x	0.7	=	190.68	(76)
East	0.9x	0.77	x	6.59	x	73.59	x	0.63	x	0.7	=	148.21	(76)
East	0.9x	0.77	x	6.59	x	45.59	x	0.63	x	0.7	=	91.82	(76)
East	0.9x	0.77	x	6.59	x	24.49	x	0.63	x	0.7	=	49.32	(76)
East	0.9x	0.77	x	6.59	x	16.15	x	0.63	x	0.7	=	32.53	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.56	77.38	127.43	185.85	227.77	233.16	221.98	190.68	148.21	91.82	49.32	32.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	373.64	408.77	446.41	485.44	507.91	494.57	471.65	446.54	414.4	377.59	357.37	357.19	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.71	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.66	19.78	20.02	20.35	20.66	20.89	20.97	20.96	20.79	20.39	19.97	19.64	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.73	0.52	0.57	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.12	18.3	18.65	19.13	19.57	19.85	19.92	19.92	19.74	19.2	18.58	18.1	(90)

fLA = Living area ÷ (4) = 0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.87	19.03	19.32	19.73	20.1	20.36	20.44	20.43	20.26	19.78	19.26	18.85	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.87	19.03	19.32	19.73	20.1	20.36	20.44	20.43	20.26	19.78	19.26	18.85	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.91	0.77	0.59	0.64	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.39	406.48	441.01	469.5	461.72	381.4	277.77	286.25	362.24	368.62	355.22	356.23	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1127.77	1090.32	986.92	823.96	638.1	432.9	288.33	302.12	464.58	697.1	927.73	1122.83	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	562	459.55	406.16	255.21	131.23	0	0	0	0	244.39	412.21	570.35	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3041.09	(98)
Space heating requirement in kWh/m²/year	47.89	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	562	459.55	406.16	255.21	131.23	0	0	0	0	244.39	412.21	570.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	601.72	492.02	434.86	273.24	140.5	0	0	0	0	261.66	441.33	610.65		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3255.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)	183.17	160	166.47	147.65	142.95	125.9	120.63	134.47	135.95	154.81	165.26	178.87		
Efficiency of water heater													80.3	(216)
(217)m=	87.69	87.56	87.21	86.42	84.84	80.3	80.3	80.3	80.3	86.2	87.26	87.76		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	208.88	182.74	190.88	170.86	168.5	156.79	150.22	167.46	169.31	179.6	189.39	203.8		
Total = Sum(219a)$_{1...12}$ =													2138.44	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3255.98	
Water heating fuel used			2138.44	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			327.71	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	703.29	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	461.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1165.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	170.08	(268)
Total CO2, kg/year		sum of (265)…(271) =		1374.2	(272)

TER =	21.64	(273)