

# Full SAP Calculation Printout



Property Reference	CPG-7172-23 P15		Issued on Date	13/01/2024	
Assessment Reference	SEC1 - ASHP ROI TF 0.15 improv	Prop Type Ref	DS		
Property	Plots 15, Collygree Parc, South Road, Penzance, Cornwall, TR20 9LY				
SAP Rating	98 A	DER	-0.65	TER	10.59
Environmental	101 A	% DER < TER			106.14
CO <sub>2</sub> Emissions (t/year)	-0.12	DFEE	27.88	TFEE	30.84
Compliance Check	See BREL	% DFEE < TFEE			9.58
% DPER < TPER	89.28	DPER	5.91	TPER	55.16
Assessor Details	Mr. Stuart Thomas			Assessor ID	V220-0003
Client	Cornwall Planning Group, CPG				

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 199.6000 (5)

### 2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	1.0000 (17)	
Infiltration rate	0.0500 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0425 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000 (22)	
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750 (22a)	
Adj infilt rate	0.0542 0.0531 0.0521 0.0468 0.0457 0.0404 0.0404 0.0393 0.0425 0.0457 0.0478 0.0499 (22b)	
Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		81.0000 (23c)
Effective ac	0.1492 0.1481 0.1471 0.1417 0.1407 0.1354 0.1354 0.1343 0.1375 0.1407 0.1428 0.1449 (25)	

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			11.9700	1.1450	13.7061		(27)
Door			2.1200	1.0000	2.1200		(26a)
Floor 1 P/a 0.25			40.0000	0.1200	4.8000	110.0000	4400.0000 (28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1500	2.6085	9.0000	156.5100 (29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1500	1.1760	9.0000	70.5600 (29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1500	1.5870	9.0000	95.2200 (29a)
External Roof 1 Horz	40.0000		40.0000	0.0900	3.6000	9.0000	360.0000 (30)
Total net area of external elements Aum (A, m <sup>2</sup> )			129.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.5976		(33)
Party Wall 1			79.8400	0.0000	0.0000	20.0000	1596.8000 (32)
Internal Wall 1 GF			34.1300			9.0000	307.1700 (32c)
Internal Wall 2 FF			60.2000			9.0000	541.8000 (32c)
Internal Floor 1			40.0000			18.0000	720.0000 (32d)
Internal Ceiling 1			40.0000			9.0000	360.0000 (32e)

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Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 8608.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 107.6008 (35)

List of Thermal Bridges

Element	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	10.0000	0.0210	0.2100
E10 Eaves (insulation at ceiling level)	10.0000	0.0440	0.4400
E6 Intermediate floor within a dwelling	10.0000	0.0800	0.8000
E2 Other lintels (including other steel lintels)	10.3100	0.0840	0.8660
E3 Sill	8.4000	0.0430	0.3612
E4 Jamb	25.2000	0.0340	0.8568
P1 Party wall - Ground floor	16.0000	0.1490	2.3840
P2 Party wall - Intermediate floor within a dwelling	16.0000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.0000	0.4800	3.8400
E18 Party wall between dwellings	19.9600	0.0395	0.7884
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.5465 (36)
Point Thermal bridges			0.0000 (36a)
Total fabric heat loss			40.1441 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	9.8267	9.7567	9.6867	9.3368	9.2668	8.9169	8.9169	8.8469	9.0569	9.2668	9.4068	9.5467 (38)
Heat transfer coeff	49.9707	49.9008	49.8308	49.4809	49.4109	49.0609	49.0609	48.9910	49.2009	49.4109	49.5508	49.6908 (39)
Average = Sum(39)m / 12 =												49.4634

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6246	0.6238	0.6229	0.6185	0.6176	0.6133	0.6133	0.6124	0.6150	0.6176	0.6194	0.6211 (40)
HLP (average)												0.6183
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4629 (42)

Hot water usage for mixer showers 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42a)

Hot water usage for baths 75.5424 74.4205 72.8406 69.9276 67.7463 65.3277 64.0212 65.5901 67.2982 69.8863 72.8593 75.2870 (42b)

Hot water usage for other uses 39.8522 38.4030 36.9538 35.5047 34.0555 32.6063 32.6063 34.0555 35.5047 36.9538 38.4030 39.8522 (42c)

Average daily hot water use (litres/day) 106.2689 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.3945	112.8235	109.7944	105.4322	101.8018	97.9340	96.6275	99.6456	102.8029	106.8401	111.2623	115.1391 (44)
Energy conte	182.7567	160.6591	168.7499	144.3314	137.0448	120.4213	116.8626	123.3820	126.7662	144.9810	158.5135	180.2801 (45)
Energy content (annual)												Total = Sum(45)m = 1764.7487
Distribution loss (46)m = 0.15 x (45)m	27.4135	24.0989	25.3125	21.6497	20.5567	18.0632	17.5294	18.5073	19.0149	21.7472	23.7770	27.0420 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (64)
Total per year (kWh/year)												2354.0047 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	100.8037	89.5817	96.1465	86.7358	85.6045	78.7857	78.8940	81.0616	80.8954	88.2433	91.4513	99.9802 (65)

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.0636	129.6061	117.0636	120.9657	117.0636	120.9657	117.0636	117.0636	120.9657	117.0636	120.9657	117.0636 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144 (71)
Water heating gains (Table 5)	135.4889	133.3061	129.2291	120.4664	115.0598	109.4245	106.0403	108.9538	112.3547	118.6066	127.0158	134.3821 (72)
Total internal gains	531.9359	544.5728	522.2150	505.1384	480.4092	464.1829	447.2142	447.8506	460.8919	475.4577	503.1895	521.1468 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
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Northeast		4.4100		11.2829		0.7600		0.7000		0.7700		18.3445 (75)
Southwest		7.5600		36.7938		0.7600		0.7000		0.7700		102.5514 (79)

Solar gains	120.8959	212.0238	306.2851	406.6304	480.2215	487.6405	465.6048	409.0375	340.7732	238.6953	145.9151	102.7437 (83)
Total gains	652.8318	756.5965	828.5001	911.7688	960.6306	951.8234	912.8190	856.8881	801.6650	714.1530	649.1046	623.8905 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.8505	47.9177	47.9850	48.3243	48.3927	48.7379	48.7379	48.8075	48.5993	48.3927	48.2560	48.1201
alpha	4.1900	4.1945	4.1990	4.2216	4.2262	4.2492	4.2492	4.2538	4.2400	4.2262	4.2171	4.2080
util living area	0.8920	0.8309	0.7488	0.6137	0.4671	0.3279	0.2361	0.2623	0.4170	0.6584	0.8315	0.9050 (86)
Living	20.3680	20.5394	20.7001	20.8399	20.9028	20.9231	20.9265	20.9261	20.9156	20.8299	20.5962	20.3276
Non living	19.6614	19.8705	20.0633	20.2280	20.2972	20.3213	20.3242	20.3248	20.3132	20.2208	19.9463	19.6146
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.6767	20.5394	20.7001	20.8399	20.9028	20.9231	20.9265	20.9261	20.9156	20.8299	20.5962	20.4217 (87)
Th 2	20.4079	20.4087	20.4094	20.4134	20.4142	20.4181	20.4181	20.4189	20.4165	20.4142	20.4126	20.4110 (88)
util rest of house	0.8814	0.8165	0.7297	0.5896	0.4398	0.2986	0.2050	0.2294	0.3834	0.6301	0.8148	0.8954 (89)
MIT 2	20.1103	19.8705	20.0633	20.2280	20.2972	20.3213	20.3242	20.3248	20.3132	20.2208	19.9463	19.7581 (90)
Living area fraction									FLA = Living area / (4) =			0.4205 (91)
MIT	20.3485	20.1518	20.3310	20.4853	20.5519	20.5744	20.5775	20.5776	20.5665	20.4769	20.2196	20.0371 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3485	20.1518	20.3310	20.4853	20.5519	20.5744	20.5775	20.5776	20.5665	20.4769	20.2196	20.0371 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8803	0.8099	0.7271	0.5926	0.4462	0.3065	0.2135	0.2384	0.3921	0.6332	0.8089	0.8888 (94)
Useful gains	574.7101	612.7412	602.3624	540.3258	428.6661	291.7446	194.9208	204.3143	314.3130	452.2128	525.0814	554.5339 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	801.9542	761.0766	689.2113	573.2509	437.3777	293.1076	195.1390	204.6669	318.1569	488.0285	650.0865	786.9594 (97)
Space heating kWh	169.0696	99.6814	64.6156	23.7061	6.4814	0.0000	0.0000	0.0000	0.0000	26.6469	90.0036	172.9246 (98a)
Space heating requirement - total per year (kWh/year)												653.1291
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	169.0696	99.6814	64.6156	23.7061	6.4814	0.0000	0.0000	0.0000	0.0000	26.6469	90.0036	172.9246 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												653.1291
Space heating per m2										(98c) / (4) =		8.1641 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												398.1535 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	169.0696	99.6814	64.6156	23.7061	6.4814	0.0000	0.0000	0.0000	0.0000	26.6469	90.0036	172.9246 (98)
Space heating efficiency (main heating system 1)	398.1535	398.1535	398.1535	398.1535	398.1535	0.0000	0.0000	0.0000	0.0000	398.1535	398.1535	398.1535 (210)
Space heating fuel (main heating system)	42.4634	25.0359	16.2288	5.9540	1.6279	0.0000	0.0000	0.0000	0.0000	6.6926	22.6053	43.4316 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating												
Water heating requirement	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (216)
Fuel for water heating, kWh/month	113.7512	100.5875	106.9072	94.1871	91.4156	82.5043	81.5543	84.7398	85.6045	95.2934	101.1167	112.5410 (219)

Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	11.8300	10.6852	11.8300	11.4484	11.8300	11.4484	11.8300	11.8300	11.4484	11.8300	11.4484	11.8300 (231)
Lighting	22.6332	18.1572	16.3485	11.9776	9.2519	7.5588	8.4399	10.9704	14.2495	18.6961	21.1172	23.2622 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-41.3315	-60.9054	-91.5256	-105.9871	-116.6320	-109.5834	-108.1057	-101.1305	-87.8308	-70.7685	-46.0749	-35.3265 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-18.1785	-41.1127	-88.2551	-141.7954	-194.0081	-197.3280	-194.1408	-160.1991	-112.2678	-61.4024	-25.0756	-14.0778 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												164.0395 (211)

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Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	204.6600
Water heating fuel used	1150.2026 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5720)	
mechanical ventilation fans (SFP = 0.5720)	139.2889 (230a)
Total electricity for the above, kWh/year	139.2889 (231)
Electricity for lighting (calculated in Appendix L)	182.6625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2223.0433 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	-586.8498 (238)

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	164.0395	0.1578	25.8795 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1150.2026	0.1408	161.9882 (264)
Space and water heating			187.8678 (265)
Pumps, fans and electric keep-hot	139.2889	0.1387	19.3211 (267)
Energy for lighting	182.6625	0.1443	26.3638 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-975.2020	0.1339	-130.5687
PV Unit electricity exported	-1247.8413	0.1243	-155.0511
Total			-285.6198 (269)
Total CO2, kg/year			-52.0671 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.6500 (273)

## 13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	164.0395	1.5840	259.8347 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1150.2026	1.5208	1749.1725 (278)
Space and water heating			2009.0071 (279)
Pumps, fans and electric keep-hot	139.2889	1.5128	210.7162 (281)
Energy for lighting	182.6625	1.5338	280.1739 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-975.2020	1.4948	-1457.7269
PV Unit electricity exported	-1247.8413	0.4560	-569.0634
Total			-2026.7903 (283)
Total Primary energy kWh/year			473.1069 (286)
Dwelling Primary energy Rate (DPER)			5.9100 (287)

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF TARGET EMISSIONS

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 199.6000 (5)

### 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1503 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4003 (18)

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Number of sides sheltered

2 (19)

Shelter factor

$$(20) = 1 - [0.075 \times (19)] = 0.8500 \quad (20)$$

Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.3403 \quad (21)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3403	0.3658	0.3828	0.3998 (22b)
	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Semi-glazed door			2.1200	1.0000	2.1200		(26a)
TER Opening Type (Uw = 1.20)			11.9700	1.1450	13.7061		(27)
Floor 1 P/s 0.25			40.0000	0.1300	5.2000		(28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1800	3.1302		(29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1800	1.4112		(29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1800	1.9044		(29a)
External Roof 1 Horz	40.0000		40.0000	0.1100	4.4000		(30)
Total net area of external elements Aum(A, m2)			129.9000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 31.8719		(33)
Party Wall 1			79.8400	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

107.6008 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	10.0000	0.1600	1.6000
E10 Eaves (insulation at ceiling level)	10.0000	0.0600	0.6000
E6 Intermediate floor within a dwelling	10.0000	0.0000	0.0000
E2 Other lintels (including other steel lintels)	10.3100	0.0500	0.5155
E3 Sill	8.4000	0.0500	0.4200
E4 Jamb	25.2000	0.0500	1.2600
P1 Party wall - Ground floor	16.0000	0.0800	1.2800
P2 Party wall - Intermediate floor within a dwelling	16.0000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.0000	0.1200	0.9600
E18 Party wall between dwellings	19.9600	0.0600	1.1976

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

7.8331 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

$$(33) + (36) + (36a) = 39.7050 \quad (37)$$

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	39.1323	38.8916	38.6557	37.5476	37.3403	36.3751	36.3751	36.1964	36.7469	37.3403	37.7597	38.1982 (38)
Average = Sum(39)m / 12 =	78.8373	78.5967	78.3607	77.2526	77.0453	76.0801	76.0801	75.9014	76.4519	77.0453	77.4647	77.9032 (39)
												77.2516

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9855	0.9825	0.9795	0.9657	0.9631	0.9510	0.9510	0.9488	0.9556	0.9631	0.9683	0.9738 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy

2.4629 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	75.5424	74.4205	72.8406	69.9276	67.7463	65.3277	64.0212	65.5901	67.2982	69.8863	72.8593	75.2870 (42b)
Hot water usage for other uses	39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522 (42c)
Average daily hot water use (litres/day)												106.2689 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.3945	112.8235	109.7944	105.4322	101.8018	97.9340	96.6275	99.6456	102.8029	106.8401	111.2623	115.1391 (44)
Energy conte	182.7567	160.6591	168.7499	144.3314	137.0448	120.4213	116.8626	123.3820	126.7662	144.9810	158.5135	180.2801 (45)
Energy content (annual)												1764.7487
Distribution loss (46)m = 0.15 x (45)m	27.4135	24.0989	25.3125	21.6497	20.5567	18.0632	17.5294	18.5073	19.0149	21.7472	23.7770	27.0420 (46)

Water storage loss:

Store volume 250.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day):

1.8903 (48)

Temperature factor from Table 2b

0.5400 (49)

Enter (49) or (54) in (55)

1.0208 (55)

Total storage loss

31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (56)

If cylinder contains dedicated solar storage

31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (57)

Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)

Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)

Total heat required for water heating calculated for each month

237.6635 210.2523 223.6567 197.4670 191.9516 173.5569 171.7694 178.2888 179.9019 199.8878 211.6491 235.1869 (62)

WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)

PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)

Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)

FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)

Output from w/h 237.6635 210.2523 223.6567 197.4670 191.9516 173.5569 171.7694 178.2888 179.9019 199.8878 211.6491 235.1869 (64)

Total per year (kWh/year) = Sum(64)m = 2411.2319 (64)

12Total per year (kWh/year)

Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

104.6920 93.0937 100.0348 90.4987 89.4928 82.5485 82.7823 84.9500 84.6583 92.1316 95.2142 103.8686 (65)

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## 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	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.0636	129.6061	117.0636	120.9657	117.0636	120.9657	117.0636	117.0636	120.9657	117.0636	120.9657	117.0636	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)	140.7151	138.5323	134.4553	125.6926	120.2861	114.6508	111.2665	114.1800	117.5809	123.8328	132.2420	139.6083	(72)
Total internal gains	540.1621	552.7990	530.4412	513.3646	488.6354	469.4091	452.4404	453.0769	466.1181	483.6839	511.4157	529.3730	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
Northeast	4.4100	11.2829	0.6300	0.7000	0.7000	0.7700	15.2066 (75)					
Southwest	7.5600	36.7938	0.6300	0.7000	0.7000	0.7700	85.0097 (79)					
Solar gains	100.2164	175.7565	253.8942	337.0752	398.0783	404.2283	385.9619	339.0705	282.4830	197.8658	120.9559	85.1691 (83)
Total gains	640.3785	728.5555	784.3355	850.4398	886.7137	873.6374	838.4023	792.1474	748.6011	681.5497	632.3716	614.5421 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.3299	30.4228	30.5144	30.9521	31.0354	31.4291	31.4291	31.5031	31.2762	31.0354	30.8673	30.6936	30.6936
alpha	3.0220	3.0282	3.0343	3.0635	3.0690	3.0953	3.0953	3.1002	3.0851	3.0690	3.0578	3.0462	3.0462
util living area	0.9384	0.9106	0.8703	0.7883	0.6690	0.5129	0.3850	0.4206	0.6117	0.8115	0.9084	0.9444 (86)	
MIT	19.1550	19.4464	19.8282	20.3137	20.6796	20.8986	20.9687	20.9583	20.8188	20.3551	19.6971	19.1143 (87)	
Th 2	20.0955	20.0980	20.1004	20.1121	20.1142	20.1244	20.1244	20.1262	20.1205	20.1142	20.1098	20.1052 (88)	
util rest of house	0.9301	0.8989	0.8532	0.7608	0.6267	0.4538	0.3134	0.3475	0.5536	0.7810	0.8945	0.9368 (89)	
MIT 2	17.9462	18.3110	18.7860	19.3819	19.8057	20.0445	20.1063	20.1009	19.9673	19.4448	18.6382	17.9016 (90)	
Living area fraction	18.4545	18.7884	19.2242	19.7737	20.1731	20.4037	20.4689	20.4614	20.3253	19.8276	19.0835	18.4115 (92)	0.4205 (91)
Temperature adjustment	18.4545	18.7884	19.2242	19.7737	20.1731	20.4037	20.4689	20.4614	20.3253	19.8276	19.0835	18.4115 (93)	0.0000
adjusted MIT	18.4545	18.7884	19.2242	19.7737	20.1731	20.4037	20.4689	20.4614	20.3253	19.8276	19.0835	18.4115 (93)	0.0000

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9109	0.8784	0.8339	0.7492	0.6297	0.4732	0.3420	0.3761	0.5678	0.7699	0.8751	0.9184 (94)	
Useful gains	583.3196	639.9504	654.0740	637.1836	558.3715	413.4058	286.7618	297.9565	425.0792	524.7418	553.4132	564.4029 (95)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.0000	14.1000	10.6000	7.1000	4.2000 (96)	
Heat loss rate W	1115.9048	1091.5845	997.0780	840.0237	652.8159	441.5455	294.3471	308.2677	475.9384	710.9419	928.2973	1107.1241 (97)	
Space heating kWh	396.2434	303.4981	255.1950	146.0449	70.2666	0.0000	0.0000	0.0000	0.0000	138.5329	269.9165	403.7846 (98a)	
Space heating requirement - total per year (kWh/year)												1983.4820	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)	
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	396.2434	303.4981	255.1950	146.0449	70.2666	0.0000	0.0000	0.0000	0.0000	138.5329	269.9165	403.7846 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												1983.4820	
Space heating per m2												24.7935 (99)	

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													92.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	396.2434	303.4981	255.1950	146.0449	70.2666	0.0000	0.0000	0.0000	0.0000	138.5329	269.9165	403.7846 (98)	
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)	
Space heating fuel (main heating system)	429.2994	328.8170	276.4843	158.2285	76.1285	0.0000	0.0000	0.0000	0.0000	150.0898	292.4340	437.4698 (211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	237.6635	210.2523	223.6567	197.4670	191.9516	173.5569	171.7694	178.2888	179.9019	199.8878	211.6491	235.1869 (64)	
Efficiency of water heater												79.8000 (216)	

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(217)m	85.1975	84.8822	84.3564	83.3934	82.0278	79.8000	79.8000	79.8000	79.8000	83.2541	84.6062	85.2607	(217)
Fuel for water heating, kWh/month													
(233a)m	278.9560	247.6990	265.1332	236.7897	234.0079	217.4898	215.2499	223.4195	225.4409	240.0937	250.1578	275.8445	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	24.3235	19.5132	17.5695	12.8722	9.9428	8.1234	9.0702	11.7898	15.3137	20.0924	22.6944	24.9995	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-37.2969	-52.5119	-75.3791	-84.6330	-91.1561	-85.0432	-83.9913	-79.3464	-71.1273	-59.9927	-40.9790	-32.2535	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-21.2710	-44.7299	-88.8765	-133.4482	-176.4177	-177.2501	-175.1642	-148.3248	-108.7361	-63.9544	-28.3952	-16.8217	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2148.9512	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2910.2820	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												196.3046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1977.1002	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												3364.4376	(238)

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2148.9512	0.2100	451.2798 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2910.2820	0.2100	611.1592 (264)
Space and water heating			1062.4390 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	196.3046	0.1443	28.3328 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-793.7104	0.1346	-106.8461
PV Unit electricity exported	-1183.3898	0.1259	-148.9938
Total			-255.8399 (269)
Total CO2, kg/year			846.8611 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.5900 (273)

## 13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2148.9512	1.1300	2428.3149 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2910.2820	1.1300	3288.6187 (278)
Space and water heating			5716.9335 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	196.3046	1.5338	301.0985 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-793.7104	1.4975	-1188.5970
PV Unit electricity exported	-1183.3898	0.4622	-546.9101
Total			-1735.5071 (283)
Total Primary energy kWh/year			4412.6257 (286)
Target Primary Energy Rate (TPER)			55.1600 (287)

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

### CALCULATION OF FABRIC ENERGY EFFICIENCY

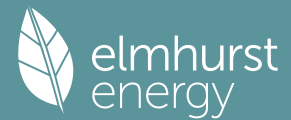
#### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	199.6000 (5)





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Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	91.7409	80.2234	83.9218	71.7920	68.0054	59.6548	58.1716	61.7003	63.6353	72.8185	79.5545	90.5711	881.7897	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	91.7409	80.2234	83.9218	71.7920	68.0054	59.6548	58.1716	61.7003	63.6353	72.8185	79.5545	90.5711	881.7897	(64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =												882	(64)
Electric shower(s)	52.4656	46.7473	51.0463	48.7128	49.6269	47.3393	48.9172	49.6269	48.7128	51.0463	50.0864	52.4656	596.7935	(64a)
Heat gains from water heating, kWh/month	36.0516	31.7427	33.7420	30.1262	29.4081	26.7485	26.7722	27.8318	28.0870	30.9662	32.4102	35.7592		(65)

## 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	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.0636	129.6061	117.0636	120.9657	117.0636	120.9657	117.0636	117.0636	120.9657	117.0636	120.9657	117.0636	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)	48.4565	47.2361	45.3522	41.8420	39.5270	37.1507	35.9841	37.4083	39.0098	41.6212	45.0142	48.0634	(72)
Total internal gains	444.9035	458.5028	438.3381	426.5140	404.8763	391.9091	377.1581	376.3052	387.5470	398.4723	421.1879	434.8282	(73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Northeast	4.4100	11.2829	0.7600	0.7000	0.7700	18.3445 (75)							
Southwest	7.5600	36.7938	0.7600	0.7000	0.7700	102.5514 (79)							
Solar gains	120.8959	212.0238	306.2851	406.6304	480.2215	487.6405	465.6048	409.0375	340.7732	238.6953	145.9151	102.7437	(83)
Total gains	565.7995	670.5266	744.6232	833.1444	885.0978	879.5496	842.7629	785.3426	728.3201	637.1676	567.1030	537.5718	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	32.0398	32.0657	32.0911	32.2110	32.2336	32.3389	32.3389	32.3585	32.2983	32.2336	32.1880	32.1405		
alpha	3.1360	3.1377	3.1394	3.1474	3.1489	3.1559	3.1559	3.1572	3.1532	3.1489	3.1459	3.1427		
util living area	0.9523	0.9220	0.8771	0.7866	0.6577	0.5000	0.3740	0.4148	0.6126	0.8260	0.9253	0.9585	(86)	
MIT	19.1417	19.4701	19.8770	20.3610	20.7164	20.9119	20.9734	20.9627	20.8297	20.3547	19.6642	19.0686	(87)	
Th 2	20.1396	20.1403	20.1409	20.1438	20.1444	20.1469	20.1469	20.1474	20.1460	20.1444	20.1433	20.1421	(88)	
util rest of house	0.9457	0.9117	0.8610	0.7596	0.6163	0.4429	0.3058	0.3440	0.5557	0.7974	0.9137	0.9527	(89)	
MIT 2	18.4402	18.7607	19.1547	19.6128	19.9314	20.0928	20.1349	20.1296	20.0331	19.6181	18.9575	18.3703	(90)	
Living area fraction	18.7352	19.0590	19.4584	19.9274	20.2615	20.4372	20.4875	20.4799	20.3681	19.9279	19.2547	18.6640	(91)	
MIT	18.7352	19.0590	19.4584	19.9274	20.2615	20.4372	20.4875	20.4799	20.3681	19.9279	19.2547	18.6640	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.7352	19.0590	19.4584	19.9274	20.2615	20.4372	20.4875	20.4799	20.3681	19.9279	19.2547	18.6640	(93)	

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	527.4728	601.0317	630.2373	626.6587	550.7381	407.0838	281.0111	292.2742	416.0111	502.9141	509.9651	505.3773	(94)	
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)	
Heat loss rate W	1077.2967	1055.8308	965.5400	818.5998	635.1029	431.5994	287.4389	301.4865	464.0437	691.9522	902.9262	1076.0625	(97)	
Space heating kWh	409.0690	305.6250	249.4653	138.1976	62.7674	0.0000	0.0000	0.0000	0.0000	140.6443	282.9320	424.5898	(98a)	
Space heating requirement - total per year (kWh/year)													2013.2903	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)	
Solar heating contribution - total per year (kWh/year)													0.0000	
Space heating kWh	409.0690	305.6250	249.4653	138.1976	62.7674	0.0000	0.0000	0.0000	0.0000	140.6443	282.9320	424.5898	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)													2013.2903	
Space heating per m2													(98c) / (4) =	25.1661 (99)

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## 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
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	695.0327	547.1534	561.6012	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8702	0.9149	0.8946	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	604.8318	500.5702	502.3849	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh						978.3372	937.7884	873.0146	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	268.9239	325.2903	275.7485	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh						67.2310	81.3226	68.9371	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												217.4907 (107)
Energy for space heating												25.1661 (99)
Energy for space cooling												2.7186 (108)
Total												27.8848 (109)
Fabric Energy Efficiency (DFEE)												27.9 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 199.6000 (5)

## 2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1503 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4003 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3403 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3403	0.3658	0.3828	0.3998 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Semi-glazed door			2.1200	1.0000	2.1200		(26a)
TER Opening Type (Uw = 1.20)			11.9700	1.1450	13.7061		(27)
Floor 1 P/a 0.25			40.0000	0.1300	5.2000		(28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1800	3.1302		(29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1800	1.4112		(29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1800	1.9044		(29a)
External Roof 1 Horz	40.0000		40.0000	0.1100	4.4000		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			129.9000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	31.8719	(33)
Party Wall 1			79.8400	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							107.6008 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E5 Ground floor (normal)				10.0000	0.1600	1.6000	
E10 Eaves (insulation at ceiling level)				10.0000	0.0600	0.6000	
E6 Intermediate floor within a dwelling				10.0000	0.0000	0.0000	
E2 Other lintels (including other steel lintels)				10.3100	0.0500	0.5155	



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.3299	30.4228	30.5144	30.9521	31.0354	31.4291	31.4291	31.5031	31.2762	31.0354	30.8673	30.6936
alpha	3.0220	3.0282	3.0343	3.0635	3.0690	3.0953	3.0953	3.1002	3.0851	3.0690	3.0578	3.0462
util living area	0.9580	0.9343	0.8995	0.8242	0.7098	0.5517	0.4188	0.4595	0.6589	0.8523	0.9351	0.9629 (86)
MIT	18.9520	19.2636	19.6732	20.2070	20.6190	20.8757	20.9604	20.9467	20.7758	20.2386	19.5221	18.9081 (87)
Th 2	20.0955	20.0980	20.1004	20.1121	20.1142	20.1244	20.1244	20.1262	20.1205	20.1142	20.1098	20.1052 (88)
util rest of house	0.9520	0.9252	0.8852	0.7992	0.6686	0.4907	0.3423	0.3816	0.6009	0.8258	0.9245	0.9575 (89)
MIT 2	18.2229	18.5296	18.9303	19.4477	19.8248	20.0470	20.1063	20.1005	19.9702	19.4891	18.7959	18.1866 (90)
Living area fraction									FLA = Living area / (4) =			0.4205 (91)
MIT	18.5295	18.8383	19.2427	19.7670	20.1587	20.3955	20.4654	20.4563	20.3089	19.8043	19.1012	18.4900 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5295	18.8383	19.2427	19.7670	20.1587	20.3955	20.4654	20.4563	20.3089	19.8043	19.1012	18.4900 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9386	0.9095	0.8693	0.7884	0.6708	0.5103	0.3727	0.4118	0.6140	0.8152	0.9098	0.9450 (94)
Useful gains	511.6350	576.8767	601.7239	602.0063	538.6511	406.2481	284.4425	294.6152	411.4223	486.1514	493.2185	491.4193 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1121.8142	1095.5000	998.5248	839.5017	651.7062	440.9202	294.0829	307.8813	474.6859	709.1446	929.6726	1113.2362 (97)
Space heating kWh	453.9733	348.5149	295.2199	170.9967	84.1130	0.0000	0.0000	0.0000	0.0000	165.9069	314.2469	462.6318 (98a)
Space heating requirement - total per year (kWh/year)												2295.6034
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	453.9733	348.5149	295.2199	170.9967	84.1130	0.0000	0.0000	0.0000	0.0000	165.9069	314.2469	462.6318 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2295.6034
Space heating per m2											(98c) / (4) =	28.6950 (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
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	715.1534	562.9931	576.8508	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8281	0.8827	0.8599	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	592.1992	496.9770	496.0607	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	880.8425	844.6992	791.2351	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	207.8232	258.7053	219.6098	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	51.9558	64.6763	54.9024	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												171.5346 (107)
Energy for space heating												28.6950 (99)
Energy for space cooling												2.1442 (108)
Total												30.8392 (109)
Fabric Energy Efficiency (TFEE)												30.8 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	199.6000 (5)

## 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door

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Measured/design AP50												1.0000 (17)
Infiltration rate												0.0500 (18)
Number of sides sheltered												2 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) = 0.0425 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Balanced mechanical ventilation with heat recovery	0.0542	0.0531	0.0521	0.0468	0.0457	0.0404	0.0404	0.0393	0.0425	0.0457	0.0478	0.0499 (22b)
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1492	0.1481	0.1471	0.1417	0.1407	0.1354	0.1354	0.1343	0.1375	0.1407	0.1428	0.1449 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Window (Uw = 1.20)			11.9700	1.1450	13.7061			(27)				
Door			2.1200	1.0000	2.1200			(26a)				
Floor 1 P/a 0.25			40.0000	0.1200	4.8000	110.0000	4400.0000	(28a)				
External Wall 1 Render	24.9500	7.5600	17.3900	0.1500	2.6085	9.0000	156.5100	(29a)				
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1500	1.1760	9.0000	70.5600	(29a)				
External Wall 3 clad	13.1000	2.5200	10.5800	0.1500	1.5870	9.0000	95.2200	(29a)				
External Roof 1 Horz	40.0000		40.0000	0.0900	3.6000	9.0000	360.0000	(30)				
Total net area of external elements Aum(A, m2)			129.9000					(31)				
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 29.5976			(33)				
Party Wall 1			79.8400	0.0000	0.0000	20.0000	1596.8000	(32)				
Internal Wall 1 GF			34.1300			9.0000	307.1700	(32c)				
Internal Wall 2 FF			60.2000			9.0000	541.8000	(32c)				
Internal Floor 1			40.0000			18.0000	720.0000	(32d)				
Internal Ceiling 1			40.0000			9.0000	360.0000	(32e)				
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 8608.0600	(34)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							107.6008	(35)				
List of Thermal Bridges												
K1 Element				Length	Psi-value		Total					
E5 Ground floor (normal)				10.0000	0.0210		0.2100					
E10 Eaves (insulation at ceiling level)				10.0000	0.0440		0.4400					
E6 Intermediate floor within a dwelling				10.0000	0.0800		0.8000					
E2 Other lintels (including other steel lintels)				10.3100	0.0840		0.8660					
E3 Sill				8.4000	0.0430		0.3612					
E4 Jamb				25.2000	0.0340		0.8568					
P1 Party wall - Ground floor				16.0000	0.1490		2.3840					
P2 Party wall - Intermediate floor within a dwelling				16.0000	0.0000		0.0000					
P4 Party wall - Roof (insulation at ceiling level)				8.0000	0.4800		3.8400					
E18 Party wall between dwellings				19.9600	0.0395		0.7884					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5465	(36)				
Point Thermal bridges							0.0000	(36a)				
Total fabric heat loss							(33) + (36) + (36a) = 40.1441	(37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	9.8267	9.7567	9.6867	9.3368	9.2668	8.9169	8.9169	8.8469	9.0569	9.2668	9.4068	9.5467 (38)
Average = Sum(39)m / 12 =	49.9707	49.9008	49.8308	49.4809	49.4109	49.0609	49.0609	48.9910	49.2009	49.4109	49.5508	49.6908 (39)
HLP	0.6246	0.6238	0.6229	0.6185	0.6176	0.6133	0.6133	0.6124	0.6150	0.6176	0.6194	0.6211 (40)
HLP (average)												0.6183
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4629 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												75.5424 (42b)
Hot water usage for other uses												39.8522 (42c)
Average daily hot water use (litres/day)												36.9538 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.3945	112.8235	109.7944	105.4322	101.8018	97.9340	96.6275	99.6456	102.8029	106.8401	111.2623	115.1391 (44)
Energy content (annual)	182.7567	160.6591	168.7499	144.3314	137.0448	120.4213	116.8626	123.3820	126.7662	144.9810	158.5135	180.2801 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1764.7487
Water storage loss:	27.4135	24.0989	25.3125	21.6497	20.5567	18.0632	17.5294	18.5073	19.0149	21.7472	23.7770	27.0420 (46)
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

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Output from w/h	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (64)
	Total per year (kWh/year) = Sum(64)m = 2354.0047 (64)											
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)											
Heat gains from water heating, kWh/month	100.8037	89.5817	96.1465	86.7358	85.6045	78.7857	78.8940	81.0616	80.8954	88.2433	91.4513	99.9802 (65)

## 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	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.8578	22.9666	18.6777	14.1402	10.5700	8.9236	9.6423	12.5334	16.8223	21.3598	24.9301	26.5764 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	327.5232	330.9219	322.3573	304.1245	281.1088	259.4772	245.0260	241.6274	250.1919	268.4248	291.4405	313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144 (71)
Water heating gains (Table 5)	135.4889	133.3061	129.2291	120.4664	115.0598	109.4245	106.0403	108.9538	112.3547	118.6066	127.0158	134.3821 (72)
Total internal gains	590.3671	588.6919	571.7614	540.2283	508.2358	479.3226	462.2058	464.6119	480.8662	509.8884	544.8836	575.5277 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast	4.4100	11.2829	0.7600	0.7000	0.7000	18.3445 (75)						
Southwest	7.5600	36.7938	0.7600	0.7000	0.7700	102.5514 (79)						
Solar gains	120.8959	212.0238	306.2851	406.6304	480.2215	487.6405	465.6048	409.0375	340.7732	238.6953	145.9151	102.7437 (83)
Total gains	711.2630	800.7156	878.0465	946.8588	988.4573	966.9632	927.8107	873.6493	821.6393	748.5837	690.7987	678.2714 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	47.8505	47.9177	47.9850	48.3243	48.3927	48.7379	48.7379	48.8075	48.5993	48.3927	48.2560	48.1201
alpha	4.1900	4.1945	4.1990	4.2216	4.2262	4.2492	4.2492	4.2538	4.2400	4.2262	4.2171	4.2080
util living area	0.8659	0.8088	0.7220	0.5954	0.4549	0.3229	0.2323	0.2573	0.4074	0.6354	0.8071	0.8816 (86)
Living	20.4423	20.5815	20.7301	20.8492	20.9050	20.9233	20.9265	20.9262	20.9166	20.8421	20.6357	20.4016
Non living	19.7518	19.9205	20.0978	20.2381	20.2994	20.3215	20.3243	20.3249	20.3140	20.2337	19.9928	19.7049
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7147	20.5815	20.7301	20.8492	20.9050	20.9233	20.9265	20.9262	20.9166	20.8421	20.6357	20.4853 (87)
Th 2	20.4079	20.4087	20.4094	20.4134	20.4142	20.4181	20.4181	20.4189	20.4165	20.4142	20.4126	20.4110 (88)
util rest of house	0.8537	0.7935	0.7023	0.5715	0.4282	0.2940	0.2017	0.2251	0.3744	0.6072	0.7892	0.8705 (89)
MIT 2	20.1463	19.9205	20.0978	20.2381	20.2994	20.3215	20.3243	20.3249	20.3140	20.2337	19.9928	19.8322 (90)
Living area fraction										FLA = Living area / (4) =		0.4205 (91)
MIT	20.3853	20.1984	20.3637	20.4950	20.5541	20.5746	20.5775	20.5777	20.5674	20.4895	20.2631	20.1068 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3853	20.1984	20.3637	20.4950	20.5541	20.5746	20.5775	20.5777	20.5674	20.4895	20.2631	20.1068 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.8533	0.7877	0.7008	0.5749	0.4346	0.3018	0.2101	0.2339	0.3830	0.6109	0.7844	0.8643 (94)
Ext temp.	606.8904	630.7634	615.3149	544.3065	429.5940	291.8349	194.9364	204.3438	314.6837	457.3029	541.8796	586.2475 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Space heating kWh	803.7952	763.4041	690.8389	573.7319	437.4876	293.1183	195.1409	204.6706	318.2011	488.6504	652.2445	790.4221 (97)
Space heating requirement - total per year (kWh/year)	146.4972	89.1345	56.1898	21.1863	5.8729	0.0000	0.0000	0.0000	0.0000	23.3225	79.4628	151.9059 (98a)
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Space heating contribution - total per year (kWh/year)	146.4972	89.1345	56.1898	21.1863	5.8729	0.0000	0.0000	0.0000	0.0000	23.3225	79.4628	151.9059 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												573.5718
Space heating per m2										(98c) / (4) =		7.1696 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												398.1535 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Space heating efficiency (main heating system 1)	146.4972	89.1345	56.1898	21.1863	5.8729	0.0000	0.0000	0.0000	0.0000	23.3225	79.4628	151.9059	(98)
Space heating fuel (main heating system)	398.1535	398.1535	398.1535	398.1535	398.1535	0.0000	0.0000	0.0000	0.0000	398.1535	398.1535	398.1535	(210)
Space heating efficiency (main heating system 2)	36.7941	22.3870	14.1126	5.3211	1.4750	0.0000	0.0000	0.0000	0.0000	5.8577	19.9578	38.1526	(211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265	(64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	(216)
Fuel for water heating, kWh/month	113.7512	100.5875	106.9072	94.1871	91.4156	82.5043	81.5543	84.7398	85.6045	95.2934	101.1167	112.5410	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	11.8300	10.6852	11.8300	11.4484	11.8300	11.4484	11.8300	11.8300	11.4484	11.8300	11.4484	11.8300	(231)
Lighting	22.6332	18.1572	16.3485	11.9776	9.2519	7.5588	8.4399	10.9704	14.2495	18.6961	21.1172	23.2622	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-41.2341	-60.7967	-91.3616	-105.9061	-116.6058	-109.5834	-108.1057	-101.1305	-87.8308	-70.7145	-46.0039	-35.2536	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-18.2759	-41.2214	-88.4191	-141.8764	-194.0342	-197.3280	-194.1408	-160.1991	-112.2678	-61.4564	-25.1466	-14.1508	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												144.0580	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												204.6600	(216)
Water heating fuel used												1150.2026	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5720)													
mechanical ventilation fans (SFP = 0.5720)												139.2889	(230a)
Total electricity for the above, kWh/year												139.2889	(231)
Electricity for lighting (calculated in Appendix L)												182.6625	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2223.0433	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												-606.8313	(238)

## 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	144.0580	16.4900	23.7552	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1150.2026	16.4900	189.6684	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	139.2889	16.4900	22.9687	(249)
Energy for lighting	182.6625	16.4900	30.1210	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-974.5267	16.4900	-160.6995	
PV Unit electricity exported	-1248.5166	5.5900	-69.7921	
Total			-230.4915	(252)
Total energy cost			36.0218	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		0.1037	(257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	98.3183	
SAP rating (Section 12)		98	(258)
SAP band		A	

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	144.0580	0.1577	22.7234	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1150.2026	0.1408	161.9882	(264)
Space and water heating			184.7116	(265)
Pumps, fans and electric keep-hot	139.2889	0.1387	19.3211	(267)
Energy for lighting	182.6625	0.1443	26.3638	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-974.5267	0.1339	-130.4653	

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PV Unit electricity exported	-1248.5166	0.1243	-155.1692
Total			-285.6345 (269)
Total CO2, kg/year			-55.2380 (272)
CO2 emissions per m2			-0.6900 (273)
EI value			100.5922
EI rating			101 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 199.6000 (5)

## 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		1.0000 (17)
Infiltration rate		0.0500 (18)
Number of sides sheltered		2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0425 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.6000	6.2000	6.1000	5.6000	5.5000	4.7000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000 (22)
Wind factor	1.6500	1.5500	1.5250	1.4000	1.3750	1.1750	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250 (22a)
Adj infilt rate	0.0701	0.0659	0.0648	0.0595	0.0584	0.0499	0.0489	0.0478	0.0531	0.0616	0.0638	0.0691 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1651	0.1609	0.1598	0.1545	0.1534	0.1449	0.1439	0.1428	0.1481	0.1566	0.1587	0.1641 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			11.9700	1.1450	13.7061		(27)
Door			2.1200	1.0000	2.1200		(26a)
Floor 1 P/a 0.25			40.0000	0.1200	4.8000	110.0000	4400.0000 (28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1500	2.6085	9.0000	156.5100 (29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1500	1.1760	9.0000	70.5600 (29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1500	1.5870	9.0000	95.2200 (29a)
External Roof 1 Horz	40.0000		40.0000	0.0900	3.6000	9.0000	360.0000 (30)
Total net area of external elements Aum(A, m2)			129.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.5976		(33)
Party Wall 1			79.8400	0.0000	0.0000	20.0000	1596.8000 (32)
Internal Wall 1 GF			34.1300			9.0000	307.1700 (32c)
Internal Wall 2 FF			60.2000			9.0000	541.8000 (32c)
Internal Floor 1			40.0000			18.0000	720.0000 (32d)
Internal Ceiling 1			40.0000			9.0000	360.0000 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				8608.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							107.6008 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	10.0000	0.0210	0.2100
E10 Eaves (insulation at ceiling level)	10.0000	0.0440	0.4400
E6 Intermediate floor within a dwelling	10.0000	0.0800	0.8000
E2 Other lintels (including other steel lintels)	10.3100	0.0840	0.8660
E3 Sill	8.4000	0.0430	0.3612
E4 Jamb	25.2000	0.0340	0.8568
P1 Party wall - Ground floor	16.0000	0.1490	2.3840
P2 Party wall - Intermediate floor within a dwelling	16.0000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.0000	0.4800	3.8400
E18 Party wall between dwellings	19.9600	0.0395	0.7884
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.5465 (36)





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util living area	0.7847	0.7280	0.6507	0.5404	0.4253	0.2991	0.2437	0.2451	0.3457	0.5270	0.6931	0.7906 (86)
Living	20.6484	20.7260	20.8030	20.8722	20.9085	20.9234	20.9256	20.9257	20.9210	20.8885	20.7913	20.6528
Non living	19.9918	20.0848	20.1733	20.2539	20.2933	20.3142	20.3170	20.3179	20.3098	20.2719	20.1643	19.9991
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.8201	20.7260	20.8030	20.8722	20.9085	20.9234	20.9256	20.9257	20.9210	20.8885	20.7913	20.7014 (87)
Th 2	20.3961	20.3993	20.4000	20.4040	20.4047	20.4110	20.4118	20.4126	20.4087	20.4024	20.4008	20.3969 (88)
util rest of house												
MIT 2	0.7657	0.7071	0.6276	0.5157	0.3987	0.2724	0.2140	0.2147	0.3135	0.4945	0.6667	0.7710 (89)
Living area fraction	20.2349	20.0848	20.1733	20.2539	20.2933	20.3142	20.3170	20.3179	20.3098	20.2719	20.1643	20.0708 (90)
MIT	20.4810	20.3544	20.4380	20.5139	20.5520	20.5704	20.5729	20.5735	20.5668	20.5312	20.4279	20.3360 (91)
Temperature adjustment												0.0000
adjusted MIT	20.4810	20.3544	20.4380	20.5139	20.5520	20.5704	20.5729	20.5735	20.5668	20.5312	20.4279	20.3360 (92)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7685	0.7054	0.6291	0.5203	0.4053	0.2797	0.2221	0.2230	0.3221	0.5016	0.6679	0.7690 (94)
Useful gains	576.4499	585.9884	578.2769	528.9610	423.4639	300.6069	216.6863	211.4575	286.0408	396.9978	487.5096	543.7751 (95)
Ext temp.	7.0000	7.3000	8.1000	9.6000	12.0000	14.5000	16.2000	16.3000	14.8000	12.4000	9.8000	7.6000 (96)
Heat loss rate W	687.8078	662.3883	625.1762	549.1943	429.7422	301.6413	216.9866	211.7530	287.7684	410.3033	537.7807	648.9048 (97)
Space heating kWh	82.8503	51.3407	34.8931	14.5680	4.6711	0.0000	0.0000	0.0000	0.0000	9.8993	36.1952	78.2165 (98a)
Space heating requirement - total per year (kWh/year)												312.6342
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	82.8503	51.3407	34.8931	14.5680	4.6711	0.0000	0.0000	0.0000	0.0000	9.8993	36.1952	78.2165 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												312.6342
Space heating per m2												3.9079 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												398.4510 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	82.8503	51.3407	34.8931	14.5680	4.6711	0.0000	0.0000	0.0000	0.0000	9.8993	36.1952	78.2165 (98)
Space heating efficiency (main heating system 1)	398.4510	398.4510	398.4510	398.4510	398.4510	0.0000	0.0000	0.0000	0.0000	398.4510	398.4510	398.4510 (210)
Space heating fuel (main heating system)	20.7931	12.8851	8.7572	3.6562	1.1723	0.0000	0.0000	0.0000	0.0000	2.4845	9.0840	19.6301 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	232.8031	205.8623	218.7963	192.7634	187.0912	168.8533	166.9090	173.4284	175.1982	195.0274	206.9455	230.3265 (64)
Efficiency of water heater												204.6600 (216)
(217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (217)
Fuel for water heating, kWh/month	113.7512	100.5875	106.9072	94.1871	91.4156	82.5043	81.5543	84.7398	85.6045	95.2934	101.1167	112.5410 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	11.8300	10.6852	11.8300	11.4484	11.8300	11.4484	11.8300	11.4484	11.8300	11.4484	11.8300	11.8300 (231)
Lighting	22.6332	18.1572	16.3485	11.9776	9.2519	7.5588	8.4399	10.9704	14.2495	18.6961	21.1172	23.2622 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-52.4910	-67.9954	-100.1201	-116.0321	-123.2491	-119.8836	-113.2134	-110.3132	-98.0808	-80.2186	-56.1342	-43.9825 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-28.9026	-52.2531	-108.9022	-178.0360	-225.3878	-255.5678	-220.8712	-201.4735	-145.8547	-80.4291	-37.1969	-21.5390 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												78.4624 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												204.6600
Water heating fuel used												1150.2026 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5720)												
mechanical ventilation fans (SFP = 0.5720)												139.2889 (230a)
Total electricity for the above, kWh/year												139.2889 (231)
Electricity for lighting (calculated in Appendix L)												182.6625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2638.1280 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

# Full SAP Calculation Printout



Appendix Q - special features  
 Energy saved or generated  
 Energy used  
 Total delivered energy for all uses

-0.0000 (236)  
 0.0000 (237)  
 -1087.5116 (238)

## 10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	78.4624	25.1600	19.7411 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1150.2026	25.1600	289.3910 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	139.2889	25.1600	35.0451 (249)
Energy for lighting	182.6625	25.1600	45.9579 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1081.7141	25.1600	-272.1593
PV Unit electricity exported	-1556.4139	5.8100	-90.4276
Total			-362.5869 (252)
Total energy cost			27.5482 (255)

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	78.4624	0.1578	12.3776 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1150.2026	0.1408	161.9882 (264)
Space and water heating			174.3658 (265)
Pumps, fans and electric keep-hot	139.2889	0.1387	19.3211 (267)
Energy for lighting	182.6625	0.1443	26.3638 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1081.7141	0.1345	-145.4439
PV Unit electricity exported	-1556.4139	0.1252	-194.7855
Total			-340.2294 (269)
Total CO2, kg/year			-120.1787 (272)

## 13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	78.4624	1.5840	124.2811 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1150.2026	1.5208	1749.1725 (278)
Space and water heating			1873.4535 (279)
Pumps, fans and electric keep-hot	139.2889	1.5128	210.7162 (281)
Energy for lighting	182.6625	1.5338	280.1739 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1081.7141	1.4969	-1619.2248
PV Unit electricity exported	-1556.4139	0.4594	-714.9779
Total			-2334.2027 (283)
Total Primary energy kWh/year			30.1409 (286)

## SAP 10 EPC IMPROVEMENTS

SEC1 - ASHP ROI TF 0.15 improv

Current energy efficiency rating: A 98  
 Current environmental impact rating: A 101

N Solar water heating Recommended  
 U Solar photovoltaic panels Already installed  
 V2 Wind turbine Not applicable

Recommended measures:  
 N Solar water heating SAP change + 1.7 Cost change -£ 69 CO2 change -40 kg (33.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£69	0.50 kg/m <sup>2</sup>	A 100 A 101
<b>Total Savings</b>	<b>£69</b>	<b>0.50 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 100  
 Potential environmental impact rating: A 101

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

	Current	Potential	Saving
Electricity	£390	£309	£81
Space heating	£55	£75	-£20
Water heating	£289	£188	£102
Lighting	£46	£46	£0
Generated (PV)	-£363	-£351	-£12
Total cost of fuels	£27	-£42	£69
Total cost of uses	£27	-£42	£70

# Full SAP Calculation Printout



Delivered energy	-14 kWh/m <sup>2</sup>	-18 kWh/m <sup>2</sup>	4 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.1 tonnes	-0.2 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	-2 kg/m <sup>2</sup>	-2 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	0 kWh/m <sup>2</sup>	-5 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 199.6000 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		1.0000 (17)
Infiltration rate		0.0500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0425 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.0542	0.0531	0.0521	0.0468	0.0457	0.0404	0.0404	0.0393	0.0425	0.0457	0.0478	0.0499 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1492	0.1481	0.1471	0.1417	0.1407	0.1354	0.1354	0.1343	0.1375	0.1407	0.1428	0.1449 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			11.9700	1.1450	13.7061		(27)
Door			2.1200	1.0000	2.1200		(26a)
Floor 1 P/a 0.25			40.0000	0.1200	4.8000	110.0000	4400.0000 (28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1500	2.6085	9.0000	156.5100 (29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1500	1.1760	9.0000	70.5600 (29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1500	1.5870	9.0000	95.2200 (29a)
External Roof 1 Horz	40.0000		40.0000	0.0900	3.6000	9.0000	360.0000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			129.9000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.5976		(33)
Party Wall 1			79.8400	0.0000	0.0000	20.0000	1596.8000 (32)
Internal Wall 1 GF			34.1300			9.0000	307.1700 (32c)
Internal Wall 2 FF			60.2000			9.0000	541.8000 (32c)
Internal Floor 1			40.0000			18.0000	720.0000 (32d)
Internal Ceiling 1			40.0000			9.0000	360.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	8608.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							107.6008 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	10.0000	0.0210	0.2100
E10 Eaves (insulation at ceiling level)	10.0000	0.0440	0.4400
E6 Intermediate floor within a dwelling	10.0000	0.0800	0.8000
E2 Other lintels (including other steel lintels)	10.3100	0.0840	0.8660
E3 Sill	8.4000	0.0430	0.3612
E4 Jamb	25.2000	0.0340	0.8568
P1 Party wall - Ground floor	16.0000	0.1490	2.3840
P2 Party wall - Intermediate floor within a dwelling	16.0000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.0000	0.4800	3.8400
E18 Party wall between dwellings	19.9600	0.0395	0.7884
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.5465 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	40.1441 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	9.8267	9.7567	9.6867	9.3368	9.2668	8.9169	8.9169	8.8469	9.0569	9.2668	9.4068	9.5467 (38)
Average = Sum(39)m / 12 =	49.9707	49.9008	49.8308	49.4809	49.4109	49.0609	49.0609	48.9910	49.2009	49.4109	49.5508	49.6908 (39)
HLP	0.6246	0.6238	0.6229	0.6185	0.6176	0.6133	0.6133	0.6124	0.6150	0.6176	0.6194	0.6211 (40)
HLP (average)												0.6183
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4629 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	75.5424	74.4205	72.8406	69.9276	67.7463	65.3277	64.0212	65.5901	67.2982	69.8863	72.8593	75.2870 (42b)
Hot water usage for other uses	39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522 (42c)
Average daily hot water use (litres/day)												106.2689 (43)
Daily hot water use	115.3945	112.8235	109.7944	105.4322	101.8018	97.9340	96.6275	99.6456	102.8029	106.8401	111.2623	115.1391 (44)
Energy conte	182.7567	160.6591	168.7499	144.3314	137.0448	120.4213	116.8626	123.3820	126.7662	144.9810	158.5135	180.2801 (45)
Energy content (annual)												Total = Sum(45)m = 1764.7487
Distribution loss (46)m = 0.15 x (45)m	27.4135	24.0989	25.3125	21.6497	20.5567	18.0632	17.5294	18.5073	19.0149	21.7472	23.7770	27.0420 (46)
Water storage loss:												250.0000 (47)
Store volume												1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8640 (55)
Enter (49) or (54) in (55)												
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	232.8031	205.8623	217.4006	186.0098	174.2969	156.2465	153.8821	161.3320	169.7954	193.6317	206.9455	230.3265 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												599.3060 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												599.3060
Solar input	-0.0000	-16.2478	-57.1859	-77.6199	-99.9149	-91.8832	-91.1420	-80.4420	-56.3516	-28.5186	-0.0000	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	232.8031	189.6145	160.2146	108.3899	74.3819	64.3633	62.7401	80.8900	113.4438	165.1131	206.9455	230.3265 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month	100.8037	89.5817	95.0299	81.3329	75.3691	68.7003	68.4724	71.3845	76.5731	87.1267	91.4513	99.9802 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.8578	22.9666	18.6777	14.1402	10.5700	8.9236	9.6423	12.5334	16.8223	21.3598	24.9301	26.5764 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	327.5232	330.9219	322.3573	304.1245	281.1088	259.4772	245.0260	241.6274	250.1919	268.4248	291.4405	313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144 (71)
Water heating gains (Table 5)	135.4889	133.3061	127.7283	112.9624	101.3025	95.4171	92.0328	95.9469	106.3515	117.1058	127.0158	134.3821 (72)
Total internal gains	590.3671	588.6919	570.2606	532.7243	494.4785	465.3152	448.1984	451.6049	474.8630	508.3876	544.8836	575.5277 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	4.4100	11.2829	0.7600	0.7000	0.7700	18.3445 (75)
Southwest	7.5600	36.7938	0.7600	0.7000	0.7700	102.5514 (79)

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Solar gains	120.8959	212.0238	306.2851	406.6304	480.2215	487.6405	465.6048	409.0375	340.7732	238.6953	145.9151	102.7437 (83)
Total gains	711.2630	800.7156	876.5457	939.3548	974.7000	952.9557	913.8032	860.6424	815.6361	747.0829	690.7987	678.2714 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.8505	47.9177	47.9850	48.3243	48.3927	48.7379	48.7379	48.8075	48.5993	48.3927	48.2560	48.1201
alpha	4.1900	4.1945	4.1990	4.2216	4.2262	4.2492	4.2492	4.2538	4.2400	4.2262	4.2171	4.2080
util living area	0.8659	0.8088	0.7228	0.5992	0.4609	0.3275	0.2358	0.2612	0.4103	0.6364	0.8071	0.8816 (86)
Living	20.4423	20.5815	20.7293	20.8473	20.9040	20.9231	20.9265	20.9261	20.9163	20.8416	20.6357	20.4016
Non living	19.7518	19.9205	20.0968	20.2360	20.2983	20.3213	20.3242	20.3248	20.3138	20.2332	19.9928	19.7049
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7147	20.5815	20.7293	20.8473	20.9040	20.9231	20.9265	20.9261	20.9163	20.8416	20.6357	20.4853 (87)
Th 2	20.4079	20.4087	20.4094	20.4134	20.4142	20.4181	20.4181	20.4189	20.4165	20.4142	20.4126	20.4110 (88)
util rest of house	0.8537	0.7935	0.7032	0.5753	0.4338	0.2983	0.2048	0.2284	0.3771	0.6081	0.7892	0.8705 (89)
MIT 2	20.1463	19.9205	20.0968	20.2360	20.2983	20.3213	20.3242	20.3248	20.3138	20.2332	19.9928	19.8322 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	20.3853	20.1984	20.3628	20.4931	20.5530	20.5744	20.5775	20.5777	20.5671	20.4890	20.2631	20.1068 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.3853	20.1984	20.3628	20.4931	20.5530	20.5744	20.5775	20.5777	20.5671	20.4890	20.2631	20.1068 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8533	0.7877	0.7016	0.5786	0.4403	0.3062	0.2133	0.2374	0.3857	0.6118	0.7844	0.8643 (94)
Useful gains	606.8904	630.7634	614.9501	543.4976	429.1489	291.7516	194.9219	204.3211	314.5764	457.0965	541.8796	586.2475 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	803.7952	763.4041	690.7932	573.6343	437.4349	293.1084	195.1391	204.6678	318.1883	488.6252	652.2445	790.4221 (97)
Space heating kWh	146.4972	89.1345	56.4273	21.6984	6.1648	0.0000	0.0000	0.0000	0.0000	23.4574	79.4628	151.9059 (98a)
Space heating requirement - total per year (kWh/year)	574.7483											
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)	0.0000											
Space heating kWh	146.4972	89.1345	56.4273	21.6984	6.1648	0.0000	0.0000	0.0000	0.0000	23.4574	79.4628	151.9059 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	574.7483											
Space heating per m2	(98c) / (4) = 7.1844 (99)											

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												398.1535 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	146.4972	89.1345	56.4273	21.6984	6.1648	0.0000	0.0000	0.0000	0.0000	23.4574	79.4628	151.9059 (98)
Space heating efficiency (main heating system 1)	398.1535	398.1535	398.1535	398.1535	398.1535	0.0000	0.0000	0.0000	0.0000	398.1535	398.1535	398.1535 (210)
Space heating fuel (main heating system)	36.7941	22.3870	14.1723	5.4498	1.5483	0.0000	0.0000	0.0000	0.0000	5.8915	19.9578	38.1526 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	232.8031	189.6145	160.2146	108.3899	74.3819	64.3633	62.7401	80.8900	113.4438	165.1131	206.9455	230.3265 (64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (216)
Fuel for water heating, kWh/month	113.7512	92.6485	78.2833	52.9610	36.3442	31.4489	30.6558	39.5241	55.4304	80.6768	101.1167	112.5410 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	18.6245	16.8222	18.6245	18.0237	18.6245	18.0237	18.6245	18.6245	18.0237	18.6245	18.0237	18.6245 (231)
Lighting	22.6332	18.1572	16.3485	11.9776	9.2519	7.5588	8.4399	10.9704	14.2495	18.6961	21.1172	23.2622 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-41.3506	-60.7222	-89.6149	-101.2378	-107.7012	-100.5251	-99.1500	-94.5157	-84.8795	-70.2033	-46.1791	-35.3473 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-18.1594	-41.2959	-90.1658	-146.5447	-202.9389	-206.3863	-203.0964	-166.8139	-115.2191	-61.9676	-24.9714	-14.0571 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												144.3534 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												204.6600

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Water heating fuel used	825.3817 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5720)	
mechanical ventilation fans (SFP = 0.5720)	139.2889 (230a)
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	219.2889 (231)
Electricity for lighting (calculated in Appendix L)	182.6625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2223.0433 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	-851.3567 (238)

## 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	144.3534	16.4900	23.8039 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	825.3817	16.4900	136.1054 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	139.2889	16.4900	22.9687 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	182.6625	16.4900	30.1210 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-931.4267	16.4900	-153.5923
PV Unit electricity exported	-1291.6166	5.5900	-72.2014
Total			-225.7936 (252)
Total energy cost			0.3975 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.0011 (257)
SAP value		99.9814
SAP rating (Section 12)		100 (258)
SAP band		A

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	144.3534	0.1577	22.7652 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	825.3817	0.1462	120.6641 (264)
Space and water heating			143.4293 (265)
Pumps, fans and electric keep-hot	219.2889	0.1387	30.4181 (267)
Energy for lighting	182.6625	0.1443	26.3638 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-931.4267	0.1344	-125.1524
PV Unit electricity exported	-1291.6166	0.1239	-160.0755
Total			-285.2279 (269)
Total CO2, kg/year			-85.0167 (272)
CO2 emissions per m2			-1.0600 (273)
EI value			100.9114
EI rating			101 (274)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	40.0000 (1b)	x 2.3700 (2b)	= 94.8000 (1b) - (3b)
First floor	40.0000 (1c)	x 2.6200 (2c)	= 104.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	199.6000 (5)

### 2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)

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Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			1.0000 (17)
Infiltration rate			0.0500 (18)
Number of sides sheltered			2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0425 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	6.1000	5.6000	5.5000	4.7000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000	(22)
Wind factor	1.6500	1.5500	1.5250	1.4000	1.3750	1.1750	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250	(22a)
Adj infilt rate	0.0701	0.0659	0.0648	0.0595	0.0584	0.0499	0.0489	0.0478	0.0531	0.0616	0.0638	0.0691	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													81.0000 (23c)
Effective ac	0.1651	0.1609	0.1598	0.1545	0.1534	0.1449	0.1439	0.1428	0.1481	0.1566	0.1587	0.1641	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			11.9700	1.1450	13.7061			(27)
Door			2.1200	1.0000	2.1200			(26a)
Floor 1 P/a 0.25			40.0000	0.1200	4.8000	110.0000	4400.0000	(28a)
External Wall 1 Render	24.9500	7.5600	17.3900	0.1500	2.6085	9.0000	156.5100	(29a)
External Wall 2 Stone	11.8500	4.0100	7.8400	0.1500	1.1760	9.0000	70.5600	(29a)
External Wall 3 clad	13.1000	2.5200	10.5800	0.1500	1.5870	9.0000	95.2200	(29a)
External Roof 1 Horz	40.0000		40.0000	0.0900	3.6000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			129.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.5976			(33)
Party Wall 1			79.8400	0.0000	0.0000	20.0000	1596.8000	(32)
Internal Wall 1 GF			34.1300			9.0000	307.1700	(32c)
Internal Wall 2 FF			60.2000			9.0000	541.8000	(32c)
Internal Floor 1			40.0000			18.0000	720.0000	(32d)
Internal Ceiling 1			40.0000			9.0000	360.0000	(32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	8608.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								107.6008 (35)

List of Thermal Bridges	K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)		10.0000	0.0210	0.2100
E10 Eaves (insulation at ceiling level)		10.0000	0.0440	0.4400
E6 Intermediate floor within a dwelling		10.0000	0.0800	0.8000
E2 Other lintels (including other steel lintels)		10.3100	0.0840	0.8660
E3 Sill		8.4000	0.0430	0.3612
E4 Jamb		25.2000	0.0340	0.8568
P1 Party wall - Ground floor		16.0000	0.1490	2.3840
P2 Party wall - Intermediate floor within a dwelling		16.0000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)		8.0000	0.4800	3.8400
E18 Party wall between dwellings		19.9600	0.0395	0.7884
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				10.5465 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 40.1441 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	10.8765	10.5965	10.5265	10.1766	10.1066	9.5467	9.4768	9.4068	9.7567	10.3166	10.4565	10.8065	(38)
Heat transfer coeff	51.0205	50.7406	50.6706	50.3207	50.2507	49.6908	49.6208	49.5508	49.9008	50.4606	50.6006	50.9505	(39)
Average = Sum(39)m / 12 =												50.3148	
HLP	0.6378	0.6343	0.6334	0.6290	0.6281	0.6211	0.6203	0.6194	0.6238	0.6308	0.6325	0.6369	(40)
HLP (average)												0.6289	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.4629 (42)
Hot water usage for baths	75.5424	74.4205	72.8406	69.9276	67.7463	65.3277	64.0212	65.5901	67.2982	69.8863	72.8593	75.2870	(42b)
Hot water usage for other uses	39.8522	38.4030	36.9538	35.5047	34.0555	32.6063	32.6063	34.0555	35.5047	36.9538	38.4030	39.8522	(42c)
Average daily hot water use (litres/day)													106.2689 (43)
Daily hot water use	115.3945	112.8235	109.7944	105.4322	101.8018	97.9340	96.6275	99.6456	102.8029	106.8401	111.2623	115.1391	(44)
Energy conte	182.7567	160.6591	168.7499	144.3314	137.0448	120.4213	116.8626	123.3820	126.7662	144.9810	158.5135	180.2801	(45)
Energy content (annual)													Total = Sum(45)m = 1764.7487
Distribution loss (46)m = 0.15 x (45)m	27.4135	24.0989	25.3125	21.6497	20.5567	18.0632	17.5294	18.5073	19.0149	21.7472	23.7770	27.0420	(46)
Water storage loss:													250.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.8640 (55)
Enter (49) or (54) in (55)													



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Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	232.8031	205.8623	217.4006	186.0098	174.2969	156.2465	153.8821	161.3320	169.7954	193.6317	206.9455	230.3265 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												760.2870 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												760.2870
Solar input	-9.5843	-27.8777	-72.6433	-95.7729	-112.5478	-111.8749	-100.3437	-97.4999	-74.4755	-44.6636	-13.0032	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Output from w/h	223.2188	177.9846	144.7572	90.2369	61.7490	44.3716	53.5384	63.8320	95.3198	148.9680	193.9423	230.3265 (64)
												Total per year (kWh/year) = Sum(64a)m = 1528.2453 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month	100.8037	89.5817	95.0299	81.3329	75.3691	68.7003	68.4724	71.3845	76.5731	87.1267	91.4513	99.9802 (65)

## 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	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717	147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.8578	22.9666	18.6777	14.1402	10.5700	8.9236	9.6423	12.5334	16.8223	21.3598	24.9301	26.5764 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	327.5232	330.9219	322.3573	304.1245	281.1088	259.4772	245.0260	241.6274	250.1919	268.4248	291.4405	313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400	52.2400 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144 (71)
Water heating gains (Table 5)	135.4889	133.3061	127.7283	112.9624	101.3025	95.4171	92.0328	95.9469	106.3515	117.1058	127.0158	134.3821 (72)
Total internal gains	590.3671	588.6919	570.2606	532.7243	494.4785	465.3152	448.1984	451.6049	474.8630	508.3876	544.8836	575.5277 (73)

## 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast		4.4100	15.8649	0.7600	0.7000	0.7700	25.7941 (75)					
Southwest		7.5600	48.0626	0.7600	0.7000	0.7700	133.9596 (79)					
Solar gains	159.7537	241.9825	347.4510	476.3894	536.4903	595.5914	513.2000	483.6134	407.1773	281.5525	184.9883	131.6282 (83)
Total gains	750.1208	830.6744	917.7116	1009.1137	1030.9688	1060.9066	961.3984	935.2183	882.0402	789.9402	729.8719	707.1560 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	46.8660	47.1246	47.1897	47.5178	47.5840	48.1201	48.1880	48.2560	47.9177	47.3860	47.2549	46.9304
alpha	4.1244	4.1416	4.1460	4.1679	4.1723	4.2080	4.2125	4.2171	4.1945	4.1591	4.1503	4.1287
util living area	0.7847	0.7280	0.6515	0.5438	0.4306	0.3030	0.2472	0.2485	0.3479	0.5279	0.6931	0.7906 (86)
Living	20.6484	20.7260	20.8024	20.8710	20.9077	20.9232	20.9255	20.9256	20.9208	20.8883	20.7913	20.6528
Non living	19.9918	20.0848	20.1726	20.2525	20.2925	20.3141	20.3169	20.3178	20.3097	20.2716	20.1643	19.9991
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.8201	20.7260	20.8024	20.8710	20.9077	20.9232	20.9255	20.9256	20.9208	20.8883	20.7913	20.7014 (87)
Th 2	20.3961	20.3993	20.4000	20.4040	20.4047	20.4110	20.4118	20.4126	20.4087	20.4024	20.4008	20.3969 (88)
util rest of house	0.7657	0.7071	0.6284	0.5191	0.4038	0.2760	0.2171	0.2176	0.3155	0.4954	0.6667	0.7710 (89)
MIT 2	20.2349	20.0848	20.1726	20.2525	20.2925	20.3141	20.3169	20.3178	20.3097	20.2716	20.1643	20.0708 (90)
Living area fraction												FLA = Living area / (4) = 0.4205 (91)
MIT	20.4810	20.3544	20.4375	20.5126	20.5512	20.5702	20.5728	20.5734	20.5667	20.5309	20.4279	20.3360 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4810	20.3544	20.4375	20.5126	20.5512	20.5702	20.5728	20.5734	20.5667	20.5309	20.4279	20.3360 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.7685	0.7054	0.6299	0.5236	0.4104	0.2833	0.2254	0.2261	0.3242	0.5025	0.6679	0.7690 (94)

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Useful gains	576.4499	585.9884	578.0376	528.4186	423.1264	300.5466	216.6663	211.4387	285.9907	396.9055	487.5096	543.7751 (95)
Ext temp.	7.0000	7.3000	8.1000	9.6000	12.0000	14.5000	16.2000	16.3000	14.8000	12.4000	9.8000	7.6000 (96)
Heat loss rate W	687.8078	662.3883	625.1464	549.1287	429.7019	301.6341	216.9842	211.7507	287.7624	410.2921	537.7807	648.9048 (97)
Space heating kWh	82.8503	51.3407	35.0489	14.9113	4.8921	0.0000	0.0000	0.0000	0.0000	9.9596	36.1952	78.2165 (98a)
Space heating requirement - total per year (kWh/year)												313.4147
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	82.8503	51.3407	35.0489	14.9113	4.8921	0.0000	0.0000	0.0000	0.0000	9.9596	36.1952	78.2165 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												313.4147
Space heating per m2												(98c) / (4) = 3.9177 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												398.4510 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	82.8503	51.3407	35.0489	14.9113	4.8921	0.0000	0.0000	0.0000	0.0000	9.9596	36.1952	78.2165 (98)
Space heating efficiency (main heating system 1)	398.4510	398.4510	398.4510	398.4510	398.4510	0.0000	0.0000	0.0000	0.0000	398.4510	398.4510	398.4510 (210)
Space heating fuel (main heating system)	20.7931	12.8851	8.7963	3.7423	1.2278	0.0000	0.0000	0.0000	0.0000	2.4996	9.0840	19.6301 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	223.2188	177.9846	144.7572	90.2369	61.7490	44.3716	53.5384	63.8320	95.3198	148.9680	193.9423	230.3265 (64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (216)
Fuel for water heating, kWh/month	109.0681	86.9660	70.7306	44.0911	30.1715	21.6807	26.1597	31.1893	46.5747	72.7881	94.7632	112.5410 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	18.6245	16.8222	18.6245	18.0237	18.6245	18.0237	18.6245	18.6245	18.0237	18.6245	18.0237	18.6245 (231)
Lighting	22.6332	18.1572	16.3485	11.9776	9.2519	7.5588	8.4399	10.9704	14.2495	18.6961	21.1172	23.2622 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-52.5486	-67.6011	-97.2462	-108.8728	-111.8828	-106.3267	-102.2739	-100.5918	-92.9938	-78.8907	-56.1430	-44.1266 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-28.8450	-52.6475	-111.7762	-185.1953	-236.7541	-269.1247	-231.8107	-211.1949	-150.9417	-81.7569	-37.1882	-21.3949 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												78.6583 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												204.6600
Water heating fuel used												746.7240 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.5720)												
mechanical ventilation fans (SFP = 0.5720)												139.2889 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												219.2889 (231)
Electricity for lighting (calculated in Appendix L)												182.6625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2638.1280 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												-1410.7943 (238)

## 10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	78.6583	25.1600	19.7904 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	746.7240	25.1600	187.8758 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	139.2889	25.1600	35.0451 (249)
Pump for solar water heating	80.0000	25.1600	20.1280 (249)
Energy for lighting	182.6625	25.1600	45.9579 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1019.4979	25.1600	-256.5057
PV Unit electricity exported	-1618.6300	5.8100	-94.0424
Total			-350.5481 (252)

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Total energy cost

-41.7509 (255)

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 12a. Carbon dioxide 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	78.6583	0.1577	12.4053 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	746.7240	0.1474	110.0354 (264)
Space and water heating			122.4407 (265)
Pumps, fans and electric keep-hot	219.2889	0.1387	30.4181 (267)
Energy for lighting	182.6625	0.1443	26.3638 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1019.4979	0.1351	-137.7201
PV Unit electricity exported	-1618.6300	0.1248	-201.9742
Total			-339.6943 (269)
Total CO2, kg/year			-160.4717 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	78.6583	1.5838	124.5795 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	746.7240	1.5452	1153.8083 (278)
Space and water heating			1278.3878 (279)
Pumps, fans and electric keep-hot	219.2889	1.5128	331.7402 (281)
Energy for lighting	182.6625	1.5338	280.1739 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1019.4979	1.4993	-1528.5071
PV Unit electricity exported	-1618.6300	0.4580	-741.3403
Total			-2269.8474 (283)
Total Primary energy kWh/year			-379.5456 (286)