

# Predicted Energy Assessment



Dwelling at, 36b, Vann Road, Fernhurst, GU27 3JN

Dwelling type:

House, Detached

Date of assessment:

19/01/2024

Produced by:

Alonso Arizpe de la Pena

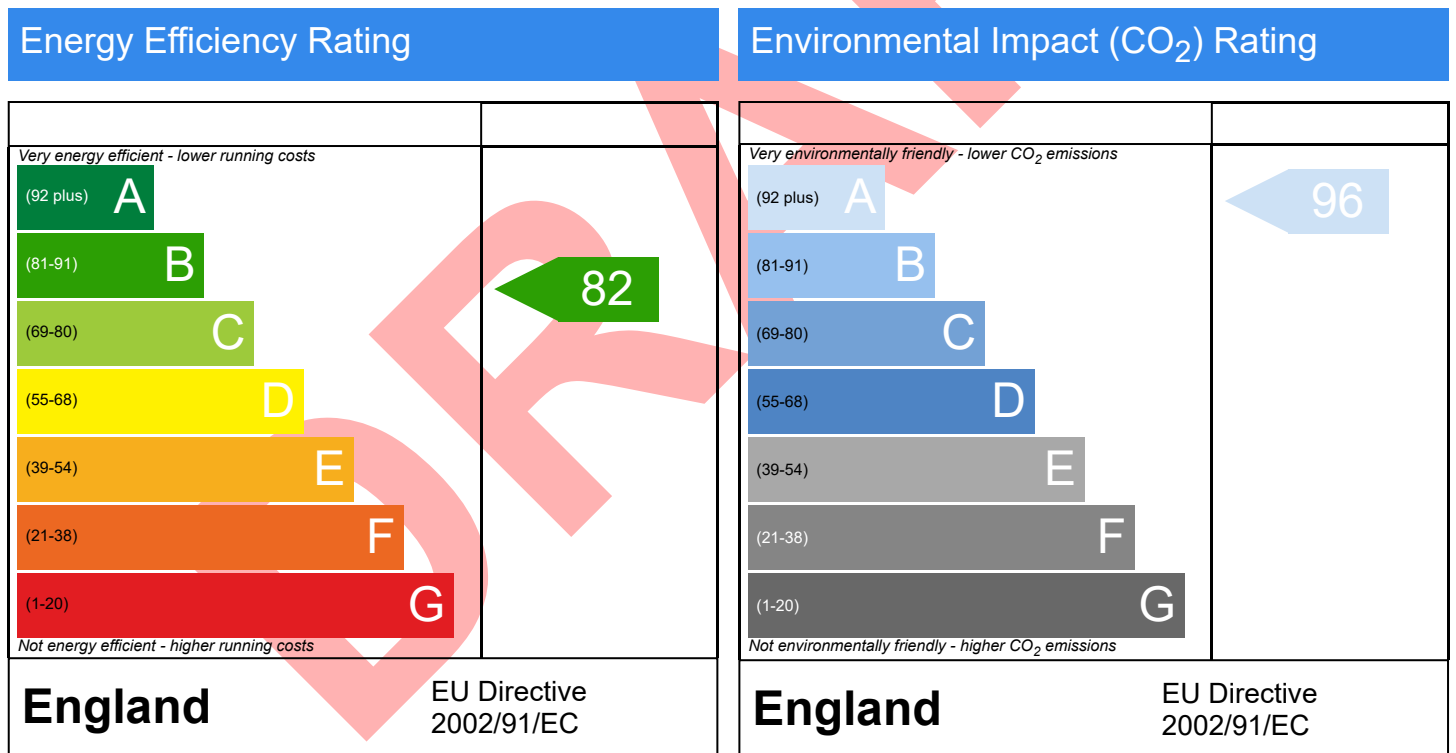
Total floor area:

201.31 m<sup>2</sup>

DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



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

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

# Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Fri 19 Jan 2024 16:49:40

Project Information			
Assessed By	Alonso Arizpe de la Pena	Building Type	House, Detached
OCDEA Registration	EES/024371	Assessment Date	2024-01-19

Dwelling Details			
Assessment Type	As designed	Total Floor Area	201 m <sup>2</sup>
Site Reference	36b Vann Road	Plot Reference	001
Address	36b Dwelling at Vann Road, Fernhurst, GU27 3JN		

Client Details	
Name	
Company	
Address	

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	8.68 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	3.38 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	45.89 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	35.18 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	43.7 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	42.4 kWh/m <sup>2</sup>	OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.21	Walls (2) (0.29)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.13	Exposed Floor (0.34)	OK
Roofs	0.16	0.12	Roof (3) (0.16)	OK
Windows, doors, and roof windows	1.6	1.2	SW Glazing (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	151.264	0.21
Exposed wall: Walls (2)	8.16	0.29
Ground floor: Ground Floor, Ground Floor	108.61	0.12
Upper floor: Exposed Floor, Exposed Floor	2.75	0.34
Exposed roof: Roof (1)	12.8876	0.11
Exposed roof: Roof (2)	54.3192	0.13
Exposed roof: Roof (3)	7.15	0.16
Exposed roof: Roof (4)	42.38	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
SW Glazing, Glazing	1.836	South West	1.0	1.2
SW Glazing, Glazing	0.735	South West	1.0	1.2
SW Glazing, Glazing	0.735	South West	1.0	1.2
SW Glazing, Glazing	2.4435	South West	1.0	1.2
SW Glazing, Glazing	1.4351	South West	1.0	1.2
SW Glazing, Glazing	1.4351	South West	1.0	1.2
SW Glazing, Glazing	1.4351	South West	1.0	1.2
Front Door, Doors	2.31	South West	N/A	1.2
SE Windows, Glazing	0.816	South East	1.0	1.2

Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
SE Windows, Glazing	0.816	South East	1.0	1.2
NE Glazing, Glazing	4.41	North East	1.0	1.2
NE Glazing, Glazing	3.318	North East	1.0	1.2
NE Glazing, Glazing	2.4435	North East	1.0	1.2
NE Glazing, Glazing	2.2987	North East	1.0	1.2
NE Glazing, Glazing	0.5715	North East	1.0	1.2
NE Glazing, Glazing	0.5715	North East	1.0	1.2
NE Glazing, Glazing	2.94	North East	1.0	1.2
NW Door, Composite Doors	2.1	North West	N/A	1.2
NW Roof Window, Roof Windows	1.0208	North West	0.7	1.2
NW Windows, Glazing	0.66	North West	1.0	1.2
NW Windows, Glazing	1.836	North West	1.0	1.2
Roof Lantern, Roof Windows	5.7824	Horizontal	0.7	1.2

### 2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part 1 - Main Dwelling : Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.23	openbacksteel
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	rcd
External wall	E4: Jamb	Calculated by person with suitable expertise	0.015 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.06	
External wall	E20: Exposed floor (normal)	SAP table default	0.32	
External wall	E21: Exposed floor (inverted)	SAP table default	0.32	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 (!)	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
External wall	E11: Eaves (insulation at rafter level)	SAP table default	0.15	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.044	
External wall	E13: Gable (insulation at rafter level)	SAP table default	0.25	
External wall	E15: Flat roof with parapet	SAP table default	0.3	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.045	
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.091	
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	
Roof	R5: Ridge (inverted)	SAP table default	0.12	
Roof	R6: Flat ceiling	SAP table default	0.12	
Roof	R7: Flat ceiling (inverted)	SAP table default	0.12	

### 3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m <sup>3</sup> /hm <sup>2</sup>	
Dwelling air permeability at 50Pa	5.01 m <sup>3</sup> /hm <sup>2</sup> , Design value	OK
Air permeability test certificate reference		

### 4 Space heating

Main heating system 1 : Heat pump with radiators or underfloor heating - Electricity

Efficiency	324.5%
Emitter type	Both radiators and underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Mitsubishi Electric Europe B.V.
Model	Ecodan 11.2kW
Commissioning	

Secondary heating system : Closed room heater	
Fuel	Wood logs
Efficiency	65.0%
Commissioning	

### 5 Hot water

Cylinder/store - type: Cylinder	
Capacity	300 litres
Declared heat loss	2.2 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

### 6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

### 7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	

### 8 Mechanical ventilation

System type: Decentralised mechanical extract		
Maximum permitted specific fan power	0.7 W/(l/s)	
Specific fan power	0.15 W/(l/s)	OK
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model	Lo-Carbon NBR dMEV C 100, 498095	
Commissioning		

### 9 Local generation

N/A
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### 10 Heat networks

N/A
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### 11 Supporting documentary evidence

N/A
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### 12 Declarations

<b>a. Assessor Declaration</b>	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed:	Assessor ID:
Name:	Date:

b. Client Declaration
N/A

# Full SAP Calculation Printout



Property Reference	36b Vann Road		Issued on Date	19/01/2024	
Assessment Reference	001	Prop Type Ref	New Build		
Property	Dwelling at, 36b, Vann Road, Fernhurst, GU27 3JN				
SAP Rating	82 B	DER	3.38	TER	8.68
Environmental	96 A	% DER < TER			61.06
CO <sub>2</sub> Emissions (t/year)	0.64	DFEE	42.44	TFEE	43.70
Compliance Check	See BREL	% DFEE < TFEE			2.89
% DPER < TPER	23.33	DPER	35.18	TPER	45.89
Assessor Details	Mr. Alonso Arizpe de la Pena			Assessor ID	Y762-0001
Client	,				

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	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	482.7982 (5)

### 2. Ventilation rate

	Value	Reference
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (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) =	20.0000 / (5) =	0.0414 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0100	(17)
Infiltration rate	0.2919	(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) =	0.2481 (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	0.3164	0.3102	0.3040	0.2730	0.2667	0.2357	0.2357	0.2295	0.2481	0.2667	0.2792	0.2916 (22b)
Mechanical extract ventilation - decentralised												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)												
Effective ac	0.5664	0.5602	0.5540	0.5230	0.5167	0.5000	0.5000	0.5000	0.5000	0.5167	0.5292	0.5416 (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
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
Doors			2.3100	1.2000	2.7720		(26)
Composite Doors			2.1000	1.2000	2.5200		(26a)
NW Roof Window			1.0200	1.1450	1.1679		(27a)
Roof Lantern			5.7800	1.1450	6.6183		(27a)
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500 (28a)
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000 (28b)
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000 (29a)
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400 (29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100 (30)
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800 (30)
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500 (30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	110.6519	(33)

# Full SAP Calculation Printout



Internal Wall 1	210.4500	75.0000	15783.7500 (32c)
Internal Wall 2	84.0500	9.0000	756.4500 (32c)
Internal Floor 1	89.9400	18.0000	1618.9200 (32d)
Internal Ceiling 1	89.9400	9.0000	809.4600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 44933.1300 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 223.2037 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.2300	5.1129
E3 Sill	14.2300	0.0200	0.2846
E4 Jamb	49.3000	0.0150	0.7395
E5 Ground floor (normal)	41.7200	0.0600	2.5032
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0020	0.0661
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.1500	1.2975
E11 Eaves (insulation at rafter level)	34.2300	0.1500	5.1345
E12 Gable (insulation at ceiling level)	9.9700	0.0440	0.4387
E13 Gable (insulation at rafter level)	18.1400	0.2500	4.5350
E15 Flat roof with parapet	8.6500	0.3000	2.5950
E16 Corner (normal)	28.1400	0.0450	1.2663
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0910	-0.2985
R1 Head of roof window	2.9600	0.2400	0.7104
R2 Sill of roof window	2.9600	0.2400	0.7104
R3 Jamb of roof window	7.8800	0.2400	1.8912
R5 Ridge (inverted)	10.0300	0.1200	1.2036
R6 Flat ceiling	51.0400	0.1200	6.1248
R7 Flat ceiling (inverted)	4.3400	0.1200	0.5208

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0664 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 147.7183 (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	90.2366	89.2483	88.2599	83.3182	82.3298	79.6617	79.6617	79.6617	79.6617	82.3298	84.3065	86.2832 (38)
Average = Sum(39)m / 12 =	237.9549	236.9666	235.9782	231.0365	230.0482	227.3800	227.3800	227.3800	227.3800	230.0482	232.0249	234.0015 (39)
HLP	1.1820	1.1771	1.1722	1.1477	1.1428	1.1295	1.1295	1.1295	1.1295	1.1428	1.1526	1.1624 (40)
HLP (average)												1.1498
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 3.0036 (42)

Hot water usage for mixer showers 119.7957 117.9954 115.3720 110.3526 106.6484 102.5176 100.1696 102.7731 105.6271 110.0624 115.1896 119.3367 (42a)

Hot water usage for baths 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42b)

Hot water usage for other uses 45.3901 43.7396 42.0890 40.4385 38.7879 37.1374 37.1374 38.7879 40.4385 42.0890 43.7396 45.3901 (42c)

Average daily hot water use (litres/day) 151.7113 (43)

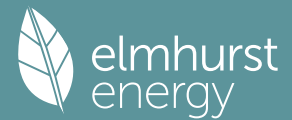
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	165.1858	161.7349	157.4610	150.7911	145.4364	139.6550	137.3070	141.5611	146.0656	152.1514	158.9291	164.7268 (44)
Energy content (annual)	261.6139	230.3084	242.0117	206.4255	195.7853	171.7221	166.0609	175.2822	180.1134	206.4680	226.4237	257.9224 (45)
Distribution loss (46)m = 0.15 x (45)m	39.2421	34.5463	36.3018	30.9638	29.3678	25.7583	24.9091	26.2923	27.0170	30.9702	33.9636	38.6884 (46)
Water storage loss:												300.0000 (47)
Store volume												2.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.1880 (55)
Enter (49) or (54) in (55)												
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (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)
FV 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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (64)
12Total per year (kWh/year)												3227.6533 (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	135.0589	119.9977	128.5412	115.1581	113.1709	103.6192	103.2876	106.3536	106.4093	116.7229	121.8075	133.8315 (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	187.7769	207.8958	187.7769	194.0361	187.7769	194.0361	187.7769	187.7769	194.0361	187.7769	194.0361	187.7769 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.2886	376.1518	366.4167	345.6918	319.5303	294.9422	278.5158	274.6527	284.3878	305.1127	331.2742	355.8623 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)												

# Full SAP Calculation Printout



Total internal gains	181.5308	178.5680	172.7704	159.9418	152.1115	143.9155	138.8274	142.9484	147.7907	156.8857	169.1770	179.8811 (72)
	809.6507	830.6700	795.0184	767.7240	727.4730	700.9482	673.1744	673.4323	694.2689	717.8296	762.5417	791.5745 (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	16.5500	11.2829	0.7600	1.0000	0.7700	98.3484 (75)						
Southeast	1.6300	36.7938	0.7600	1.0000	0.7700	31.5871 (77)						
Southwest	10.0500	36.7938	0.7600	1.0000	0.7700	194.7547 (79)						
Northwest	2.5000	11.2829	0.7600	1.0000	0.7700	14.8562 (81)						
Northwest	1.0200	17.4137	0.7600	0.7000	1.0000	8.5044 (82)						
Horizontal	5.7800	26.0000	0.7600	0.7000	1.0000	71.9541 (82)						
Solar gains	420.0049	783.1802	1241.4997	1806.6607	2256.6880	2339.7169	2214.6266	1865.7976	1436.2570	912.3667	515.6519	351.1627 (83)
Total gains	1229.6556	1613.8502	2036.5181	2574.3847	2984.1610	3040.6651	2887.8011	2539.2300	2130.5260	1630.1963	1278.1936	1142.7372 (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	52.4529	52.6717	52.8923	54.0236	54.2557	54.8924	54.8924	54.8924	54.8924	54.2557	53.7935	53.3391
alpha	4.4969	4.5114	4.5262	4.6016	4.6170	4.6595	4.6595	4.6595	4.6595	4.6170	4.5862	4.5559
util living area	0.9965	0.9880	0.9590	0.8536	0.6653	0.4704	0.3448	0.4080	0.6797	0.9387	0.9913	0.9974 (86)
Living	19.7395	19.9677	20.2936	20.6717	20.8657	20.9227	20.9315	20.9292	20.8807	20.5562	20.0786	19.7171
Non living	18.4573	18.7506	19.1617	19.6245	19.8276	19.8857	19.8909	19.8900	19.8573	19.5084	18.9088	18.4407
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	20.3552	19.9677	20.2936	20.6717	20.8657	20.9227	20.9315	20.9292	20.8807	20.5562	20.0786	19.8965 (87)
Th 2	19.9344	19.9383	19.9423	19.9621	19.9661	19.9768	19.9768	19.9768	19.9768	19.9661	19.9581	19.9502 (88)
util rest of house	0.9954	0.9845	0.9473	0.8185	0.6059	0.3986	0.2655	0.3192	0.5986	0.9151	0.9882	0.9967 (89)
MIT 2	19.3455	18.7506	19.1617	19.6245	19.8276	19.8857	19.8909	19.8900	19.8573	19.5084	18.9088	18.7127 (90)
Living area fraction										FLA = Living area / (4) = 0.2394 (91)		
MIT	19.5873	19.0420	19.4327	19.8752	20.0761	20.1340	20.1401	20.1389	20.1023	19.7593	19.1889	18.9961 (92)
Temperature adjustment												0.0000
adjusted MIT	19.5873	19.0420	19.4327	19.8752	20.0761	20.1340	20.1401	20.1389	20.1023	19.7593	19.1889	18.9961 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9949	0.9805	0.9403	0.8152	0.6125	0.4098	0.2782	0.3334	0.6092	0.9093	0.9850	0.9957 (94)
Useful gains	1223.4392	1582.3203	1914.9190	2098.6376	1827.8161	1246.1409	803.4333	846.6816	1297.8412	1482.3893	1259.0307	1137.8215 (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	3637.6804	3351.1767	3051.8440	2535.6748	1926.9169	1258.3124	804.9437	850.1417	1364.8056	2107.0802	2804.9253	3462.3205 (97)
Space heating kWh	1796.1954	1188.6715	845.8722	314.6668	73.7310	0.0000	0.0000	0.0000	0.0000	464.7700	1113.0441	1729.4273 (98a)
Space heating requirement - total per year (kWh/year)												7526.3783
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	1796.1954	1188.6715	845.8722	314.6668	73.7310	0.0000	0.0000	0.0000	0.0000	464.7700	1113.0441	1729.4273 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7526.3783
Space heating per m2												(98c) / (4) = 37.3870 (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 %)	324.5214 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	65.0000 (208)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1796.1954	1188.6715	845.8722	314.6668	73.7310	0.0000	0.0000	0.0000	0.0000	464.7700	1113.0441	1729.4273 (98)
Space heating efficiency (main heating system 1)	324.5214	324.5214	324.5214	324.5214	324.5214	0.0000	0.0000	0.0000	0.0000	324.5214	324.5214	324.5214 (210)
Space heating fuel (main heating system)	553.4907	366.2845	260.6522	96.9633	22.7199	0.0000	0.0000	0.0000	0.0000	143.2171	342.9802	532.9163 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (64)
Efficiency of water heater (217)m	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600 (216)
Fuel for water heating, kWh/month	183.2446	162.1005	172.0791	150.7049	145.7483	130.9376	128.8171	134.0696	135.7174	151.8332	162.0960	181.1419 (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	7.7173	6.9705	7.7173	7.4684	7.7173	7.4684	7.7173	7.7173	7.4684	7.7173	7.4684	7.7173 (231)
Lighting	39.0163	31.3003	28.1825	20.6477	15.9489	13.0304	14.5491	18.9115	24.5641	32.2295	36.4031	40.1007 (232)



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Electricity generated by PVs (Appendix M) (negative quantity) (233a)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	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												2319.2244	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.5600	
Water heating fuel used												1838.4902	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543) mechanical ventilation fans (SFP = 0.1543)												90.8652	(230a)
Total electricity for the above, kWh/year												90.8652	(231)
Electricity for lighting (calculated in Appendix L)												314.8841	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(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												4563.4638	(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	2319.2244	0.1568	363.7020	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1838.4902	0.1410	259.1591	(264)
Space and water heating			622.8611	(265)
Pumps, fans and electric keep-hot	90.8652	0.1387	12.6041	(267)
Energy for lighting	314.8841	0.1443	45.4475	(268)
Total CO2, kg/year			680.9127	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3800	(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	2319.2244	1.5805	3665.5840	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1838.4902	1.5212	2796.7725	(278)
Space and water heating			6462.3565	(279)
Pumps, fans and electric keep-hot	90.8652	1.5128	137.4609	(281)
Energy for lighting	314.8841	1.5338	482.9797	(282)
Total Primary energy kWh/year			7082.7970	(286)
Dwelling Primary energy Rate (DPER)			35.1800	(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	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)	
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100			(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	482.7982 (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	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)

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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) =  
 Pressure test  
 Pressure Test Method  
 Measured/design AP50  
 Infiltration rate  
 Number of sides sheltered

Air changes per hour  
 40.0000 / (5) = 0.0829 (8)  
 Yes  
 Blower Door  
 5.0000 (17)  
 0.3329 (18)  
 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2829 (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	0.3607	0.3537	0.3466	0.3112	0.3041	0.2688	0.2688	0.2617	0.2829	0.3041	0.3183	0.3324 (22b)
Effective ac	0.5651	0.5625	0.5601	0.5484	0.5463	0.5361	0.5361	0.5342	0.5400	0.5463	0.5507	0.5553 (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 Opaque door			2.3100	1.0000	2.3100		(26)
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
NW Roof Window			1.0200	1.5038	1.5338		(27a)
Roof Lantern			5.7800	1.5918	9.2004		(27a)
Ground Floor			108.6100	0.1300	14.1193		(28a)
Exposed Floor			2.7500	0.1300	0.3575		(28b)
External Walls	186.4100	35.1400	151.2700	0.1800	27.2286		(29a)
Dormer Cheeks	8.1600		8.1600	0.1800	1.4688		(29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179		(30)
Rafter Roof	55.3400	1.0200	54.3200	0.1100	5.9752		(30)
Rafter Roof Dormer	7.1500		7.1500	0.1100	0.7865		(30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618		(30)
Total net area of external elements Aum(A, m2)			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					106.3468		(32)
					(26)...(30) + (32) =		223.2037 (35)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.0500	1.1115
E3 Sill	14.2300	0.0500	0.7115
E4 Jamb	49.3000	0.0500	2.4650
E5 Ground floor (normal)	41.7200	0.1600	6.6752
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.2400	2.0760
E11 Eaves (insulation at rafter level)	34.2300	0.0400	1.3692
E12 Gable (insulation at ceiling level)	9.9700	0.0600	0.5982
E13 Gable (insulation at rafter level)	18.1400	0.0800	1.4512
E15 Flat roof with parapet	8.6500	0.5600	4.8440
E16 Corner (normal)	28.1400	0.0900	2.5326
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0900	-0.2952
R1 Head of roof window	2.9600	0.0800	0.2368
R2 Sill of roof window	2.9600	0.0600	0.1776
R3 Jamb of roof window	7.8800	0.0800	0.6304
R5 Ridge (inverted)	10.0300	0.0400	0.4012
R6 Flat ceiling	51.0400	0.0600	3.0624
R7 Flat ceiling (inverted)	4.3400	0.0400	0.1736

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.4516 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 136.7984 (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	90.0276	89.6251	89.2305	87.3773	87.0306	85.4165	85.4165	85.1176	86.0382	87.0306	87.7320	88.4653 (38)
Average = Sum(39)m / 12 =	226.8260	226.4235	226.0289	224.1758	223.8290	222.2150	222.2150	221.9161	222.8367	223.8290	224.5305	225.2638 (39)
												224.1741

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1267	1.1248	1.1228	1.1136	1.1119	1.1038	1.1038	1.1024	1.1069	1.1119	1.1153	1.1190 (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	3.0036 (42)											
Hot water usage for mixer showers	95.8365	94.3963	92.2976	88.2821	85.3188	82.0141	80.1357	82.2185	84.5017	88.0499	92.1516	95.4693 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901 (42c)
Average daily hot water use (litres/day)												129.6218 (43)
Daily hot water use	141.2267	138.1359	134.3866	128.7206	124.1067	119.1514	117.2731	121.0064	124.9401	130.1389	135.8912	140.8595 (44)
Energy conte	223.6685	196.7036	206.5472	176.2120	167.0714	146.5106	141.8316	149.8312	154.0637	176.5973	193.6020	220.5519 (45)
Energy content (annual)												Total = Sum(45)m = 2153.1910
Distribution loss (46)m = 0.15 x (45)m	33.5503	29.5055	30.9821	26.4318	25.0607	21.9766	21.2747	22.4747	23.1096	26.4896	29.0403	33.0828 (46)
Water storage loss:												300.0000 (47)
Store volume												2.1127 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.1409 (55)
Enter (49) or (54) in (55)												
Total storage loss												

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If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (56)
Primary loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (57)
Combi 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)
Total heat required for water heating calculated for each month	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)
WWHRS	282.2973	249.6587	265.1760	232.9496	225.7002	203.2482	200.4604	208.4600	210.8012	235.2261	250.3395	279.1807 (62)
FV diverter	-43.8125	-38.7481	-40.5748	-33.5975	-31.3117	-26.7936	-25.1148	-26.7070	-27.7217	-32.6808	-37.0234	-43.0011 (63a)
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 (63b)
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 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64)
12Total per year (kWh/year)	238.4848	210.9106	224.6012	199.3521	194.3886	176.4545	175.3457	181.7530	183.0795	202.5452	213.3161	236.1796 (64)
Electric shower(s)	Total per year (kWh/year) = Sum(64)m = 2436.4109 (64)											
Heat gains from water heating, kWh/month	2436 (64)											
	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)											
	121.2728	107.7680	115.5800	103.9805	102.4543	94.1048	94.0621	96.7219	96.6162	105.6216	109.7627	120.2365 (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	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.8348	210.1743	189.8348	196.1627	189.8348	196.1627	189.8348	189.8348	196.1627	189.8348	196.1627	189.8348 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.2886	376.1518	366.4167	345.6918	319.5303	294.9422	278.5158	274.6527	284.3878	305.1127	331.2742	355.8623 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	163.0011	160.3691	155.3495	144.4174	137.7074	130.7011	126.4275	130.0026	134.1892	141.9646	152.4482	161.6083 (72)
Total internal gains	796.1789	817.7495	782.6554	757.3262	718.1269	689.8604	662.8326	662.5445	682.7940	707.9665	750.9394	778.3597 (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	16.5500	11.2829	0.6300	0.7000	0.7700	57.0679 (75)						
Southeast	1.6300	36.7938	0.6300	0.7000	0.7700	18.3288 (77)						
Southwest	10.0500	36.7938	0.6300	0.7000	0.7700	113.0090 (79)						
Northwest	2.5000	11.2829	0.6300	0.7000	0.7700	8.6205 (81)						
Northwest	1.0200	17.4137	0.6300	0.7000	1.0000	7.0497 (82)						
Horizontal	5.7800	26.0000	0.6300	0.7000	1.0000	59.6461 (82)						
Solar gains	263.7221	496.0319	794.7079	1165.5242	1460.6932	1515.7696	1434.2415	1205.7380	922.7302	580.3069	324.6059	219.9344 (83)
Total gains	1059.9011	1313.7815	1577.3632	1922.8504	2178.8201	2205.6300	2097.0740	1868.2824	1605.5242	1288.2733	1075.5453	998.2941 (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)	55.0264	55.1243	55.2205	55.6770	55.7632	56.1682	56.1682	56.2439	56.0115	55.7632	55.5890	55.4080
tau	4.6684	4.6750	4.6814	4.7118	4.7175	4.7445	4.7445	4.7496	4.7341	4.7175	4.7059	4.6939
util living area	0.9981	0.9946	0.9828	0.9331	0.8058	0.6137	0.4595	0.5319	0.8073	0.9716	0.9956	0.9986 (86)
MIT	19.4043	19.6324	19.9897	20.4618	20.8089	20.9598	20.9917	20.9841	20.8583	20.3691	19.7990	19.3681 (87)
Th 2	19.9790	19.9807	19.9823	19.9898	19.9912	19.9977	19.9977	19.9989	19.9952	19.9912	19.9883	19.9854 (88)
util rest of house	0.9975	0.9929	0.9774	0.9122	0.7531	0.5296	0.3582	0.4231	0.7340	0.9591	0.9940	0.9981 (89)
MIT 2	18.1046	18.3974	18.8520	19.4393	19.8295	19.9741	19.9948	19.9928	19.8934	19.3393	18.6166	18.0627 (90)
Living area fraction	FLA = Living area / (4) = 0.2394 (91)											
MIT	18.4158	18.6931	19.1244	19.6841	20.0640	20.2101	20.2335	20.2301	20.1244	19.5859	18.8997	18.3753 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4158	18.6931	19.1244	19.6841	20.0640	20.2101	20.2335	20.2301	20.1244	19.5859	18.8997	18.3753 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	1055.8270	1300.3973	1531.8129	1739.4659	1649.9858	1209.0547	802.0362	838.8496	1195.5128	1226.8410	1066.3084	995.3647 (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	3201.8338	3123.0769	2853.4846	2417.5423	1872.1013	1246.6443	807.4200	849.9671	1342.4655	2011.3084	2649.3944	3193.1818 (97)
Space heating kWh	1596.6291	1224.8407	983.3237	488.2150	165.2539	0.0000	0.0000	0.0000	0.0000	583.6438	1139.8220	1635.1760 (98a)
Space heating requirement - total per year (kWh/year)	7816.9041											
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	1596.6291	1224.8407	983.3237	488.2150	165.2539	0.0000	0.0000	0.0000	0.0000	583.6438	1139.8220	1635.1760 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	7816.9041											
Space heating per m2	(98c) / (4) = 38.8302 (99)											

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)
Space heating requirement	1596.6291	1224.8407	983.3237	488.2150	165.2539	0.0000	0.0000	0.0000	0.0000	583.6438	1139.8220	1635.1760	(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)	1729.8256	1327.0213	1065.3562	528.9437	179.0400	0.0000	0.0000	0.0000	0.0000	632.3335	1234.9100	1771.5883	(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 requirement	238.4848	210.9106	224.6012	199.3521	194.3886	176.4545	175.3457	181.7530	183.0795	202.5452	213.3161	236.1796	(64)
Efficiency of water heater (217)m	87.5173	87.3528	86.9761	85.9882	83.6978	79.8000	79.8000	79.8000	79.8000	86.2927	87.2488	79.8000	(216)
Fuel for water heating, kWh/month	272.5003	241.4469	258.2334	231.8365	232.2504	221.1210	219.7314	227.7607	229.4230	234.7189	244.4918	269.7538	(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	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	39.4439	31.6434	28.4914	20.8740	16.1237	13.1732	14.7086	19.1187	24.8333	32.5827	36.8021	40.5402	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-88.6204	-118.8548	-162.5452	-173.4722	-179.4050	-164.5494	-162.2187	-156.5911	-145.9688	-131.0250	-95.1042	-77.3241	(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	-70.4060	-145.1810	-283.4499	-418.6727	-547.1247	-541.4533	-461.5932	-342.4053	-205.5223	-93.2642	-55.9273	-55.9273	(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													8469.0186 (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													2883.2680 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													86.0000 (231)
Total electricity for the above, kWh/year													318.3351 (232)
Electricity for lighting (calculated in Appendix L)													
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-5368.3214 (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													6388.3004 (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	8469.0186	0.2100	1778.4939	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2883.2680	0.2100	605.4863	(264)
Space and water heating			2383.9802	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	318.3351	0.1443	45.9456	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1655.6790	0.1357	-224.7019	
PV Unit electricity exported	-3712.6424	0.1264	-469.2217	
Total			-693.9235	(269)
Total CO2, kg/year			1747.9315	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.6800	(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	8469.0186	1.1300	9569.9910	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2883.2680	1.1300	3258.0929	(278)
Space and water heating			12828.0839	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	318.3351	1.5338	488.2730	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1655.6790	1.5016	-2486.2422	
PV Unit electricity exported	-3712.6424	0.4639	-1722.4440	
Total			-4208.6862	(283)
Total Primary energy kWh/year			9237.7715	(286)

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Target Primary Energy Rate (TPER)

45.8900 (287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 482.7982 (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	4 * 10 =	40.0000 (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) =	40.0000 / (5) =	0.0829 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0100 (17)
Infiltration rate		0.3334 (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) =	0.2833 (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	0.3613	0.3542	0.3471	0.3117	0.3046	0.2692	0.2692	0.2621	0.2833	0.3046	0.3188	0.3329 (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	0.5653	0.5627	0.5602	0.5486	0.5464	0.5362	0.5362	0.5343	0.5401	0.5464	0.5508	0.5554 (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
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
Doors			2.3100	1.2000	2.7720		(26)
Composite Doors			2.1000	1.2000	2.5200		(26a)
NW Roof Window			1.0200	1.1450	1.1679		(27a)
Roof Lantern			5.7800	1.1450	6.6183		(27a)
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500 (28a)
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000 (28b)
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000 (29a)
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400 (29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100 (30)
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800 (30)
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500 (30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200 (30)
Total net area of external elements Aum (A, m <sup>2</sup> )			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	110.6519		(33)
Internal Wall 1			210.4500			75.0000	15783.7500 (32c)
Internal Wall 2			84.0500			9.0000	756.4500 (32c)
Internal Floor 1			89.9400			18.0000	1618.9200 (32d)
Internal Ceiling 1			89.9400			9.0000	809.4600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	44933.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							223.2037 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.2300	5.1129
E3 Sill	14.2300	0.0200	0.2846
E4 Jamb	49.3000	0.0150	0.7395
E5 Ground floor (normal)	41.7200	0.0600	2.5032
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0020	0.0661
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.1500	1.2975
E11 Eaves (insulation at rafter level)	34.2300	0.1500	5.1345
E12 Gable (insulation at ceiling level)	9.9700	0.0400	0.4387
E13 Gable (insulation at rafter level)	18.1400	0.2500	4.5350
E15 Flat roof with parapet	8.6500	0.3000	2.5950
E16 Corner (normal)	28.1400	0.0450	1.2663
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0910	-0.2985
R1 Head of roof window	2.9600	0.2400	0.7104

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R2 Sill of roof window	2.9600	0.2400	0.7104
R3 Jamb of roof window	7.8800	0.2400	1.8912
R5 Ridge (inverted)	10.0300	0.1200	1.2036
R6 Flat ceiling	51.0400	0.1200	6.1248
R7 Flat ceiling (inverted)	4.3400	0.1200	0.5208
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			37.0664 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 147.7183 (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	90.0587	89.6550	89.2593	87.4005	87.0528	85.4338	85.4338	85.1340	86.0574	87.0528	87.7563	88.4918 (38)
Average = Sum(39)m / 12 =	237.7771	237.3733	236.9776	235.1188	234.7711	233.1522	233.1522	232.8524	233.7757	234.7711	235.4746	236.2101 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1811	1.1791	1.1772	1.1679	1.1662	1.1582	1.1582	1.1567	1.1613	1.1662	1.1697	1.1734 (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												3.0036 (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	32.1954	31.7172	31.0439	29.8024	28.8728	27.8420	27.2852	27.9538	28.6818	29.7848	31.0519	32.0866 (42b)
Hot water usage for other uses	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901 (42c)
Average daily hot water use (litres/day)												71.1139 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	77.5855	75.4568	73.1329	70.2409	67.6607	64.9794	64.4226	66.7417	69.1203	71.8738	74.7915	77.4767 (44)
Energy content (annual)	122.8765	107.4495	112.4026	96.1563	91.0843	79.8997	77.9135	82.6402	85.2322	97.5321	106.5541	121.3097 (45)
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
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 (56)
If cylinder contains dedicated solar storage												
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 (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 (59)
Total heat required for water heating calculated for each month	104.4450	91.3321	95.5422	81.7328	77.4217	67.9147	66.2265	70.2442	72.4474	82.9023	90.5710	103.1133 (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	104.4450	91.3321	95.5422	81.7328	77.4217	67.9147	66.2265	70.2442	72.4474	82.9023	90.5710	103.1133 (64)
12Total per year (kWh/year)												1003.8933 (64)
Electric shower(s)	59.7268	53.2170	58.1110	55.4546	56.4952	53.8909	55.6873	56.4952	55.4546	58.1110	57.0183	59.7268 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												679.3885 (64a)
Heat gains from water heating, kWh/month	41.0429	36.1373	38.4133	34.2969	33.4792	30.4514	30.4784	31.6848	31.9755	35.2533	36.8973	40.7100 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	187.7769	207.8958	187.7769	194.0361	187.7769	194.0361	187.7769	187.7769	194.0361	187.7769	194.0361	187.7769 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.2886	376.1518	366.4167	345.6918	319.5303	294.9422	278.5158	274.6527	284.3878	305.1127	331.2742	355.8623 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	55.1653	53.7757	51.6308	47.6345	44.9989	42.2936	40.9656	42.5872	44.4104	47.3835	51.2463	54.7178 (72)
Total internal gains	683.2851	705.8777	673.8787	655.4168	620.3605	599.3263	575.3127	573.0710	590.8886	608.3274	644.6109	666.4112 (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	16.5500	11.2829	0.7600	1.0000	0.7700	98.3484 (75)						
Southeast	1.6300	36.7938	0.7600	1.0000	0.7700	31.5871 (77)						
Southwest	10.0500	36.7938	0.7600	1.0000	0.7700	194.7547 (79)						
Northwest	2.5000	11.2829	0.7600	1.0000	0.7700	14.8562 (81)						
Northwest	1.0200	17.4137	0.7600	0.7000	1.0000	8.5044 (82)						
Horizontal	5.7800	26.0000	0.7600	0.7000	1.0000	71.9541 (82)						
Solar gains	420.0049	783.1802	1241.4997	1806.6607	2256.6880	2339.7169	2214.6266	1865.7976	1436.2570	912.3667	515.6519	351.1627 (83)
Total gains	1103.2900	1489.0579	1915.3784	2462.0774	2877.0485	2939.0432	2789.9394	2438.8687	2027.1457	1520.6941	1160.2628	1017.5739 (84)

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## 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	52.4921	52.5814	52.6692	53.0856	53.1642	53.5334	53.5334	53.6023	53.3906	53.1642	53.0054	52.8403
alpha	4.4995	4.5054	4.5113	4.5390	4.5443	4.5689	4.5689	4.5735	4.5594	4.5443	4.5337	4.5227
util living area	0.9977	0.9912	0.9670	0.8733	0.6922	0.4961	0.3653	0.4334	0.7160	0.9527	0.9941	0.9984 (86)
MIT	19.3405	19.6431	20.0834	20.5971	20.8888	20.9803	20.9961	20.9918	20.9062	20.4242	19.7716	19.2903 (87)
Th 2	19.9351	19.9367	19.9383	19.9457	19.9471	19.9536	19.9536	19.9548	19.9511	19.9471	19.9443	19.9414 (88)
util rest of house	0.9970	0.9886	0.9572	0.8406	0.6320	0.4198	0.2797	0.3378	0.6336	0.9333	0.9920	0.9979 (89)
MIT 2	18.4215	18.7236	19.1564	19.6400	19.8788	19.9452	19.9526	19.9525	19.9027	19.4976	18.8585	18.3762 (90)
Living area fraction										fLA = Living area / (4) =		0.2394 (91)
MIT	18.6416	18.9437	19.3784	19.8692	20.1206	20.1930	20.2025	20.2014	20.1430	19.7194	19.0771	18.5950 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6416	18.9437	19.3784	19.8692	20.1206	20.1930	20.2025	20.2014	20.1430	19.7194	19.0771	18.5950 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9958	0.9852	0.9507	0.8379	0.6425	0.4376	0.3002	0.3607	0.6499	0.9280	0.9894	0.9970 (94)
Useful gains	1098.6264	1466.9706	1820.9201	2063.0903	1848.4632	1286.1252	837.4834	879.6674	1317.3738	1411.1753	1147.9956	1014.5258 (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	3410.0961	3333.6082	3051.8812	2579.0568	1976.9189	1304.0263	839.9224	885.1582	1412.7008	2140.9798	2820.3142	3400.2525 (97)
Space heating kWh	1719.7334	1254.3805	915.8351	371.4959	95.5710	0.0000	0.0000	0.0000	0.0000	542.9745	1204.0694	1774.9807 (98a)
Space heating requirement - total per year (kWh/year)												7879.0405
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	1719.7334	1254.3805	915.8351	371.4959	95.5710	0.0000	0.0000	0.0000	0.0000	542.9745	1204.0694	1774.9807 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7879.0405
Space heating per m2												(98c) / (4) = 39.1388 (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	2191.6303	1725.3260	1769.6779	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9390	0.9675	0.9441	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2057.8888	1669.2277	1670.7791	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3242.4216	3077.7616	2688.9310	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	852.8636	1047.9492	757.5050	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	213.2159	261.9873	189.3763	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												664.5795 (107)
Energy for space heating												39.1388 (99)
Energy for space cooling												3.3013 (108)
Total												42.4401 (109)
Fabric Energy Efficiency (DFEE)												42.4 (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 (m2)	Storey height (m)	Volume (m3)
Ground floor	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	482.7982 (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	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Air changes per hour	

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0829 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3329 (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) =	0.2829 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	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												
	0.3607	0.3537	0.3466	0.3112	0.3041	0.2688	0.2688	0.2617	0.2829	0.3041	0.3183	0.3324 (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	0.5651	0.5625	0.5601	0.5484	0.5463	0.5361	0.5361	0.5342	0.5400	0.5463	0.5507	0.5553 (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 Opaque door			2.3100	1.0000	2.3100		(26)
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
NW Roof Window			1.0200	1.5038	1.5338		(27a)
Roof Lantern			5.7800	1.5918	9.2004		(27a)
Ground Floor			108.6100	0.1300	14.1193		(28a)
Exposed Floor			2.7500	0.1300	0.3575		(28b)
External Walls	186.4100	35.1400	151.2700	0.1800	27.2286		(29a)
Dormer Cheeks	8.1600		8.1600	0.1800	1.4688		(29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179		(30)
Rafter Roof	55.3400	1.0200	54.3200	0.1100	5.9752		(30)
Rafter Roof Dormer	7.1500		7.1500	0.1100	0.7865		(30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618		(30)
Total net area of external elements Aum(A, m2)			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	106.3468	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 223.2037 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.0500	1.1115
E3 Sill	14.2300	0.0500	0.7115
E4 Jamb	49.3000	0.0500	2.4650
E5 Ground floor (normal)	41.7200	0.1600	6.6752
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.2400	2.0760
E11 Eaves (insulation at rafter level)	34.2300	0.0400	1.3692
E12 Gable (insulation at ceiling level)	9.9700	0.0600	0.5982
E13 Gable (insulation at rafter level)	18.1400	0.0800	1.4512
E15 Flat roof with parapet	8.6500	0.5600	4.8440
E16 Corner (normal)	28.1400	0.0900	2.5326
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0900	-0.2952
R1 Head of roof window	2.9600	0.0800	0.2368
R2 Sill of roof window	2.9600	0.0600	0.1776
R3 Jamb of roof window	7.8800	0.0800	0.6304
R5 Ridge (inverted)	10.0300	0.0400	0.4012
R6 Flat ceiling	51.0400	0.0600	3.0624
R7 Flat ceiling (inverted)	4.3400	0.0400	0.1736

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.4516 (36)

#### Point Thermal bridges

Total fabric heat loss (33) + (36) + (36a) = 136.7984 (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
	90.0276	89.6251	89.2305	87.3773	87.0306	85.4165	85.4165	85.1176	86.0382	87.0306	87.7320	88.4653 (38)
Heat transfer coeff	226.8260	226.4235	226.0289	224.1758	223.8290	222.2150	222.2150	221.9161	222.8367	223.8290	224.5305	225.2638 (39)
Average = Sum(39)m / 12 =												224.1741

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1.1267	1.1248	1.1228	1.1136	1.1119	1.1038	1.1038	1.1024	1.1069	1.1119	1.1153	1.1190 (40)
HLP (average)												1.1136
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													3.0036 (42)
Hot water usage for mixer showers													0.0000 (42a)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usage for baths													32.0866 (42b)
	32.1954	31.7172	31.0439	29.8024	28.8728	27.8420	27.2852	27.9538	28.6818	29.7848	31.0519	32.0866	
Hot water usage for other uses													45.3901 (42c)
	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901	
Average daily hot water use (litres/day)													71.1139 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	77.5855	75.4568	73.1329	70.2409	67.6607	64.9794	64.4226	66.7417	69.1203	71.8738	74.7915	77.4767 (44)	
Energy conte	122.8765	107.4495	112.4026	96.1563	91.0843	79.8997	77.9135	82.6402	85.2322	97.5321	106.5541	121.3097 (45)	
Energy content (annual)													Total = Sum(45)m = 1181.0509
Distribution loss (46)m = 0.15 x (45)m													0.0000 (46)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Water storage loss:													
Total storage loss													0.0000 (56)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
If cylinder contains dedicated solar storage													0.0000 (57)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
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 (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)	



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Total heat required for water heating calculated for each month												
	104.4450	91.3321	95.5422	81.7328	77.4217	67.9147	66.2265	70.2442	72.4474	82.9023	90.5710	103.1133 (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	104.4450	91.3321	95.5422	81.7328	77.4217	67.9147	66.2265	70.2442	72.4474	82.9023	90.5710	103.1133 (64)
	Total per year (kWh/year) = Sum(64)m =											1003.8933 (64)
12Total per year (kWh/year)												1004 (64)
Electric shower(s)	59.7268	53.2170	58.1110	55.4546	56.4952	53.8909	55.6873	56.4952	55.4546	58.1110	57.0183	59.7268 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											679.3885 (64a)
Heat gains from water heating, kWh/month	41.0429	36.1373	38.4133	34.2969	33.4792	30.4514	30.4784	31.6848	31.9755	35.2533	36.8973	40.7100 (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	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812	150.1812 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.8348	210.1743	189.8348	196.1627	189.8348	196.1627	189.8348	189.8348	196.1627	189.8348	196.1627	189.8348 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.2886	376.1518	366.4167	345.6918	319.5303	294.9422	278.5158	274.6527	284.3878	305.1127	331.2742	355.8623 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181	38.0181 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	55.1653	53.7757	51.6308	47.6345	44.9989	42.2936	40.9656	42.5872	44.4104	47.3835	51.2463	54.7178 (72)
Total internal gains	685.3431	708.1562	675.9367	657.5433	622.4185	601.4529	577.3707	575.1290	593.0152	610.3854	646.7375	668.4692 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	16.5500	11.2829	0.6300	0.7000	0.7700	57.0679 (75)						
Southeast	1.6300	36.7938	0.6300	0.7000	0.7700	18.3288 (77)						
Southwest	10.0500	36.7938	0.6300	0.7000	0.7700	113.0090 (79)						
Northwest	2.5000	11.2829	0.6300	0.7000	0.7700	8.6205 (81)						
Northwest	1.0200	17.4137	0.6300	0.7000	1.0000	7.0497 (82)						
Horizontal	5.7800	26.0000	0.6300	0.7000	1.0000	59.6461 (82)						
Solar gains	263.7221	496.0319	794.7079	1165.5242	1460.6932	1515.7696	1434.2415	1205.7380	922.7302	580.3069	324.6059	219.9344 (83)
Total gains	949.0652	1204.1881	1470.6446	1823.0675	2083.1116	2117.2225	2011.6122	1780.8670	1515.7455	1190.6923	971.3434	888.4036 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	55.0264	55.1243	55.2205	55.6770	55.7632	56.1682	56.1682	56.2439	56.0115	55.7632	55.5890	55.4080
util living area	4.6684	4.6750	4.6814	4.7118	4.7175	4.7445	4.7445	4.7496	4.7341	4.7175	4.7059	4.6939
	0.9988	0.9962	0.9869	0.9438	0.8248	0.6346	0.4778	0.5551	0.8315	0.9789	0.9972	0.9991 (86)
MIT	19.3400	19.5699	19.9318	20.4187	20.7869	20.9538	20.9902	20.9810	20.8373	20.3186	19.7391	19.3042 (87)
Th 2	19.9790	19.9807	19.9823	19.9898	19.9912	19.9977	19.9977	19.9989	19.9952	19.9912	19.9883	19.9854 (88)
util rest of house	0.9985	0.9950	0.9826	0.9255	0.7743	0.5493	0.3731	0.4429	0.7618	0.9691	0.9961	0.9989 (89)
MIT 2	18.4542	18.6847	19.0450	19.5216	19.8488	19.9763	19.9950	19.9931	19.9019	19.4353	18.8598	18.4232 (90)
Living area fraction	18.6663	18.8966	19.2573	19.7364	20.0734	20.2103	20.2333	20.2296	20.1259	19.6468	19.0704	18.6342 (92)
MIT	18.6663	18.8966	19.2573	19.7364	20.0734	20.2103	20.2333	20.2296	20.1259	19.6468	19.0704	0.0000
Temperature adjustment	18.6663	18.8966	19.2573	19.7364	20.0734	20.2103	20.2333	20.2296	20.1259	19.6468	19.0704	18.6342 (93)
adjusted MIT	18.6663	18.8966	19.2573	19.7364	20.0734	20.2103	20.2333	20.2296	20.1259	19.6468	19.0704	0.0000

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9932	0.9786	0.9199	0.7789	0.5682	0.3982	0.4697	0.7721	0.9647	0.9947	0.9984 (94)	
Useful gains	946.9414	1196.0551	1439.1410	1677.1171	1622.4608	1203.0731	800.9872	836.4355	1170.3787	1148.6071	966.1692	886.9400 (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	3258.6474	3169.1606	2883.5275	2429.2560	1874.2123	1246.6987	807.3769	849.8606	1342.7851	2024.9420	2687.7085	3251.4917 (97)	
Space heating kWh	1719.9093	1325.9269	1074.6236	541.5400	187.3032	0.0000	0.0000	0.0000	0.0000	651.9932	1239.5083	1759.2264 (98a)	
Space heating requirement - total per year (kWh/year)												8500.0308	
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	1719.9093	1325.9269	1074.6236	541.5400	187.3032	0.0000	0.0000	0.0000	0.0000	651.9932	1239.5083	1759.2264 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												8500.0308	
Space heating per m2												(98c) / (4) =	42.2236 (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

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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	2088.8207	1644.3908	1686.5621	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8628	0.9200	0.8771	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1802.3358	1512.7812	1479.2612	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2297.9081	2183.1410	1931.9790	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	356.8121	498.7477	336.8221	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	89.2030	124.6869	84.2055	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												298.0955 (107)
Energy for space heating												42.2236 (99)
Energy for space cooling												1.4808 (108)
Total												43.7044 (109)
Fabric Energy Efficiency (TFEE)												43.7 (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			
First floor	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 482.7982 (5)

## 2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (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) =		20.0000 / (5) = 0.0414 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0100 (17)
Infiltration rate		0.2919 (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) =	0.2481 (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	0.3164	0.3102	0.3040	0.2730	0.2667	0.2357	0.2357	0.2295	0.2481	0.2667	0.2792	0.2916 (22b)
Mechanical extract ventilation - decentralised												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)												
Effective ac	0.5664	0.5602	0.5540	0.5230	0.5167	0.5000	0.5000	0.5000	0.5000	0.5167	0.5292	0.5416 (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
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
Doors			2.3100	1.2000	2.7720		(26)
Composite Doors			2.1000	1.2000	2.5200		(26a)
NW Roof Window			1.0200	1.1450	1.1679		(27a)
Roof Lantern			5.7800	1.1450	6.6183		(27a)
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500 (28a)
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000 (28b)
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000 (29a)
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400 (29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100 (30)
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800 (30)
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500 (30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200 (30)
Total net area of external elements Aum (A, m2)			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	110.6519	(33)
Internal Wall 1			210.4500			75.0000	15783.7500 (32c)
Internal Wall 2			84.0500			9.0000	756.4500 (32c)
Internal Floor 1			89.9400			18.0000	1618.9200 (32d)
Internal Ceiling 1			89.9400			9.0000	809.4600 (32e)

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Heat capacity Cm = Sum(A x k)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K  
 (28)...(30) + (32) + (32a)...(32e) = 44933.1300 (34)  
 223.2037 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.2300	5.1129
E3 Sill	14.2300	0.0200	0.2846
E4 Jamb	49.3000	0.0150	0.7395
E5 Ground floor (normal)	41.7200	0.0600	2.5032
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0020	0.0661
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.1500	1.2975
E11 Eaves (insulation at rafter level)	34.2300	0.1500	5.1345
E12 Gable (insulation at ceiling level)	9.9700	0.0440	0.4387
E13 Gable (insulation at rafter level)	18.1400	0.2500	4.5350
E15 Flat roof with parapet	8.6500	0.3000	2.5950
E16 Corner (normal)	28.1400	0.0450	1.2663
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0910	-0.2985
R1 Head of roof window	2.9600	0.2400	0.7104
R2 Sill of roof window	2.9600	0.2400	0.7104
R3 Jamb of roof window	7.8800	0.2400	1.8912
R5 Ridge (inverted)	10.0300	0.1200	1.2036
R6 Flat ceiling	51.0400	0.1200	6.1248
R7 Flat ceiling (inverted)	4.3400	0.1200	0.5208

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0664 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 147.7183 (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	90.2366	89.2483	88.2599	83.3182	82.3298	79.6617	79.6617	79.6617	79.6617	82.3298	84.3065	86.2832 (38)
Average = Sum(39)m / 12 =	237.9549	236.9666	235.9782	231.0365	230.0482	227.3800	227.3800	227.3800	227.3800	230.0482	232.0249	234.0015 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1820	1.1771	1.1722	1.1477	1.1428	1.1295	1.1295	1.1295	1.1295	1.1428	1.1526	1.1624 (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 3.0036 (42)

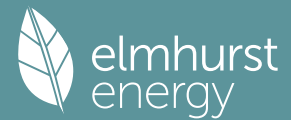
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	119.7957	117.9954	115.3720	110.3526	106.6484	102.5176	100.1696	102.7731	105.6271	110.0624	115.1896	119.3367 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901 (42c)
Average daily hot water use (litres/day)												151.7113 (43)
Daily hot water use	165.1858	161.7349	157.4610	150.7911	145.4364	139.6550	137.3070	141.5611	146.0656	152.1514	158.9291	164.7268 (44)
Energy content (annual)	261.6139	230.3084	242.0117	206.4255	195.7853	171.7221	166.0609	175.2822	180.1134	206.4680	226.4237	257.9224 (45)
Distribution loss (46)m = 0.15 x (45)m	39.2421	34.5463	36.3018	30.9638	29.3678	25.7583	24.9091	26.2923	27.0170	30.9702	33.9636	38.6884 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1880 (55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (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	135.0589	119.9977	128.5412	115.1581	113.1709	103.6192	103.2876	106.3536	106.4093	116.7229	121.8075	133.8315 (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	44.5751	39.5912	32.1977	24.3758	18.2212	15.3831	16.6220	21.6058	28.9993	36.8213	42.9759	45.8140 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	555.6547	561.4206	546.8906	515.9579	476.9109	440.2122	415.6953	409.9293	424.4594	455.3921	494.4390	531.1377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	181.5308	178.5680	172.7704	159.9418	152.1115	143.9155	138.8274	142.9484	147.7907	156.8857	169.1770	179.8811 (72)
Total internal gains	897.8585	895.6777	867.9566	816.3733	763.3414	715.6087	687.2425	690.5815	717.3473	765.1969	822.6898	872.9306 (73)

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## 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	16.5500	11.2829	0.7600	1.0000	0.7700	98.3484 (75)						
Southeast	1.6300	36.7938	0.7600	1.0000	0.7700	31.5871 (77)						
Southwest	10.0500	36.7938	0.7600	1.0000	0.7700	194.7547 (79)						
Northwest	2.5000	11.2829	0.7600	1.0000	0.7700	14.8562 (81)						
Northwest	1.0200	17.4137	0.7600	0.7000	1.0000	8.5044 (82)						
Horizontal	5.7800	26.0000	0.7600	0.7000	1.0000	71.9541 (82)						
Solar gains	420.0049	783.1802	1241.4997	1806.6607	2256.6880	2339.7169	2214.6266	1865.7976	1436.2570	912.3667	515.6519	351.1627 (83)
Total gains	1317.8633	1678.8579	2109.4563	2623.0339	3020.0294	3055.3257	2901.8691	2556.3791	2153.6043	1677.5636	1338.3417	1224.0933 (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	52.4529	52.6717	52.8923	54.0236	54.2557	54.8924	54.8924	54.8924	54.8924	54.2557	53.7935	53.3391
alpha	4.4969	4.5114	4.5262	4.6016	4.6170	4.6595	4.6595	4.6595	4.6595	4.6170	4.5862	4.5559
util living area	0.9953	0.9861	0.9539	0.8466	0.6593	0.4683	0.3432	0.4054	0.6743	0.9328	0.9896	0.9966 (86)
Living	19.7770	19.9941	20.3193	20.6818	20.8681	20.9229	20.9316	20.9293	20.8824	20.5713	20.1036	19.7519
Non living	18.5050	18.7839	19.1928	19.6353	19.8297	19.8858	19.8909	19.8901	19.8585	19.5257	18.9404	18.4852
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	20.3743	19.9941	20.3193	20.6818	20.8681	20.9229	20.9316	20.9293	20.8824	20.5713	20.1036	19.9265 (87)
Th 2	19.9344	19.9383	19.9423	19.9621	19.9661	19.9768	19.9768	19.9768	19.9768	19.9661	19.9581	19.9502 (88)
util rest of house	0.9939	0.9820	0.9409	0.8106	0.5999	0.3968	0.2642	0.3171	0.5932	0.9076	0.9859	0.9956 (89)
MIT 2	19.3646	18.7839	19.1928	19.6353	19.8297	19.8858	19.8909	19.8901	19.8585	19.5257	18.9404	18.7492 (90)
Living area fraction									fLA = Living area / (4) =			0.2394 (91)
MIT	19.6063	19.0737	19.4625	19.8858	20.0783	20.1341	20.1401	20.1389	20.1037	19.7760	19.2189	19.0311 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6063	19.0737	19.4625	19.8858	20.0783	20.1341	20.1401	20.1389	20.1037	19.7760	19.2189	19.0311 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9934	0.9776	0.9338	0.8077	0.6066	0.4079	0.2769	0.3312	0.6039	0.9020	0.9823	0.9944 (94)
Useful gains	1309.1318	1641.2677	1969.7533	2118.6319	1832.0743	1246.4015	803.4689	846.7908	1300.4824	1513.1236	1314.6764	1217.2016 (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	3642.2188	3358.6853	3058.8712	2538.1310	1927.4136	1258.3428	804.9483	850.1555	1365.1149	2110.9319	2811.8801	3470.5009 (97)
Space heating kWh	1735.8167	1154.1046	810.3037	302.0394	70.9325	0.0000	0.0000	0.0000	0.0000	444.7693	1077.9867	1676.4547 (98a)
Space heating requirement - total per year (kWh/year)												7272.4076
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	1735.8167	1154.1046	810.3037	302.0394	70.9325	0.0000	0.0000	0.0000	0.0000	444.7693	1077.9867	1676.4547 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7272.4076
Space heating per m2										(98c) / (4) =		36.1254 (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 %)												324.5214 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1735.8167	1154.1046	810.3037	302.0394	70.9325	0.0000	0.0000	0.0000	0.0000	444.7693	1077.9867	1676.4547 (98)
Space heating efficiency (main heating system 1)	324.5214	324.5214	324.5214	324.5214	324.5214	0.0000	0.0000	0.0000	0.0000	324.5214	324.5214	324.5214 (210)
Space heating fuel (main heating system)	534.8852	355.6329	249.6919	93.0723	21.8576	0.0000	0.0000	0.0000	0.0000	137.0540	332.1774	516.5930 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (64)
Efficiency of water heater (217)m	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600 (216)
Fuel for water heating, kWh/month	183.2446	162.1005	172.0791	150.7049	145.7483	130.9376	128.8171	134.0696	135.7174	151.8332	162.0960	181.1419 (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	7.7173	6.9705	7.7173	7.4684	7.7173	7.4684	7.7173	7.7173	7.4684	7.7173	7.4684	7.7173 (231)
Lighting	39.0163	31.3003	28.1825	20.6477	15.9489	13.0034	14.5491	18.9115	24.5641	32.2295	36.4031	40.1007 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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)

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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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												2240.9643	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.5600	
Water heating fuel used												1838.4902	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543) mechanical ventilation fans (SFP = 0.1543)												90.8652	(230a)
Total electricity for the above, kWh/year												90.8652	(231)
Electricity for lighting (calculated in Appendix L)												314.8841	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(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												4885.2037	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2240.9643	16.4900	369.5350	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1838.4902	16.4900	303.1670	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	90.8652	16.4900	14.9837	(249)
Energy for lighting	314.8841	16.4900	51.9244	(250)
Additional standing charges			0.0000	(251)
Total energy cost			739.6101	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.0810	(257)
SAP value		82.4771	
SAP rating (Section 12)		82	(258)
SAP band		B	

## 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	2240.9643	0.1568	351.4877	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1838.4902	0.1410	259.1591	(264)
Space and water heating			610.6468	(265)
Pumps, fans and electric keep-hot	90.8652	0.1387	12.6041	(267)
Energy for lighting	314.8841	0.1443	45.4475	(268)
Total CO2, kg/year			668.6985	(272)
CO2 emissions per m2			3.3200	(273)
EI value			96.3621	
EI rating			96	(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	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)	
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	482.7982 (5)	

### 2. Ventilation rate

m3 per hour

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Number of open chimneys 0 \* 80 = 0.0000 (6a)  
 Number of open flues 1 \* 20 = 20.0000 (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) = 20.0000 / (5) = 0.0414 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 5.0100 (17)  
 Infiltration rate 0.2919 (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) = 0.2481 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	4.1000	4.1000	3.8000	3.8000	3.5000	3.8000	4.1000	4.0000	4.3000
Wind factor	1.2000	1.1250	1.1000	1.0250	1.0250	0.9500	0.9500	0.8750	0.9500	1.0250	1.0000	1.0750
Adj infilt rate	0.2978	0.2792	0.2730	0.2543	0.2543	0.2357	0.2357	0.2171	0.2357	0.2543	0.2481	0.2667
Mechanical extract ventilation - decentralised												
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)
Effective ac	0.5478	0.5292	0.5230	0.5043	0.5043	0.5000	0.5000	0.5000	0.5000	0.5043	0.5000	0.5167

### 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
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870		(27)
Doors			2.3100	1.2000	2.7720		(26)
Composite Doors			2.1000	1.2000	2.5200		(26a)
NW Roof Window			1.0200	1.1450	1.1679		(27a)
Roof Lantern			5.7800	1.1450	6.6183		(27a)
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500 (28a)
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000 (28b)
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000 (29a)
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400 (29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100 (30)
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800 (30)
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500 (30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200 (30)
Total net area of external elements Aum(A, m2)			429.4700				(31)
Fabric heat loss, W/K = Sum (A x U)					110.6519		(26)...(30) + (32) = (33)
Internal Wall 1			210.4500			75.0000	15783.7500 (32c)
Internal Wall 2			84.0500			9.0000	756.4500 (32c)
Internal Floor 1			89.9400			18.0000	1618.9200 (32d)
Internal Ceiling 1			89.9400			9.0000	809.4600 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 44933.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							223.2037 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.2300	5.1129
E3 Sill	14.2300	0.0200	0.2846
E4 Jamb	49.3000	0.0150	0.7395
E5 Ground floor (normal)	41.7200	0.0600	2.5032
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0020	0.0661
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.1500	1.2975
E11 Eaves (insulation at rafter level)	34.2300	0.1500	5.1345
E12 Gable (insulation at ceiling level)	9.9700	0.0440	0.4387
E13 Gable (insulation at rafter level)	18.1400	0.2500	4.5350
E15 Flat roof with parapet	8.6500	0.3000	2.5950
E16 Corner (normal)	28.1400	0.0450	1.2663
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0910	-0.2985
R1 Head of roof window	2.9600	0.2400	0.7104
R2 Sill of roof window	2.9600	0.2400	0.7104
R3 Jamb of roof window	7.8800	0.2400	1.8912
R5 Ridge (inverted)	10.0300	0.1200	1.2036
R6 Flat ceiling	51.0400	0.1200	6.1248
R7 Flat ceiling (inverted)	4.3400	0.1200	0.5208
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			37.0664 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 147.7183 (37)

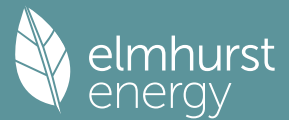
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	87.2716	84.3065	83.3182	80.3531	80.3531	79.6617	79.6617	79.6617	79.6617	80.3531	79.6617	82.3298
Average = Sum(39)m / 12 =	234.9899	232.0249	231.0365	228.0715	228.0715	227.3800	227.3800	227.3800	227.3800	228.0715	227.3800	230.0482
HLP	1.1673	1.1526	1.1477	1.1329	1.1329	1.1295	1.1295	1.1295	1.1295	1.1329	1.1295	1.1428
HLP (average)												1.1381
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												3.0036 (42)
Hot water usage for mixer showers												
Hot water usage for baths	119.7957	117.9954	115.3720	110.3526	106.6484	102.5176	100.1696	102.7731	105.6271	110.0624	115.1896	119.3367 (42a)

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Hot water usage for other uses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Average daily hot water use (litres/day)	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901 (42c) 151.7113 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	165.1858	161.7349	157.4610	150.7911	145.4364	139.6550	137.3070	141.5611	146.0656	152.1514	158.9291	164.7268 (44)
Distribution loss (46)m = 0.15 x (45)m	261.6139	230.3084	242.0117	206.4255	195.7853	171.7221	166.0609	175.2822	180.1134	206.4680	226.4237	257.9224 (45) 2520.1373
Water storage loss:	39.2421	34.5463	36.3018	30.9638	29.3678	25.7583	24.9091	26.2923	27.0170	30.9702	33.9636	38.6884 (46)
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1880 (55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (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	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128 (64) 3227.6533 (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) 0.0000 (64a)
Heat gains from water heating, kWh/month	135.0589	119.9977	128.5412	115.1581	113.1709	103.6192	103.2876	106.3536	106.4093	116.7229	121.8075	133.8315 (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	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.5751	39.5912	32.1977	24.3758	18.2212	15.3831	16.6220	21.6058	28.9993	36.8213	42.9759	45.8140 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	555.6547	561.4206	546.8906	515.9579	476.9109	440.2122	415.6953	409.9293	424.4594	455.3921	494.4390	531.1377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	181.5308	178.5680	172.7704	159.9418	152.1115	143.9155	138.8274	142.9484	147.7907	156.8857	169.1770	179.8811 (72)
Total internal gains	897.8585	895.6777	867.9566	816.3733	763.3414	715.6087	687.2425	690.5815	717.3473	765.1969	822.6898	872.9306 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	16.5500	14.1923	0.7600	1.0000	0.7700	123.7076 (75)						
Southeast	1.6300	43.9597	0.7600	1.0000	0.7700	37.7389 (77)						
Southwest	10.0500	43.9597	0.7600	1.0000	0.7700	232.6843 (79)						
Northwest	2.5000	14.1923	0.7600	1.0000	0.7700	18.6869 (81)						
Northwest	1.0200	22.0723	0.7600	0.7000	1.0000	10.7796 (82)						
Horizontal	5.7800	33.0000	0.7600	0.7000	1.0000	91.3263 (82)						
Solar gains	514.9236	831.3903	1307.1281	1957.9735	2343.5203	2617.3782	2444.2174	2090.8313	1624.7472	1037.8864	619.7823	419.3863 (83)
Total gains	1412.7821	1727.0679	2175.0847	2774.3468	3106.8617	3332.9870	3131.4599	2781.4128	2342.0945	1803.0833	1442.4722	1292.3169 (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	53.1147	53.7935	54.0236	54.7259	54.7259	54.8924	54.8924	54.8924	54.8924	54.7259	54.8924	54.2557
alpha	4.5410	4.5862	4.6016	4.6484	4.6484	4.6595	4.6595	4.6595	4.6595	4.6484	4.6595	4.6170
util living area	0.9936	0.9849	0.9448	0.8173	0.6132	0.3990	0.2970	0.3418	0.6169	0.9098	0.9854	0.9960 (86)
Living	19.8460	20.0250	20.3876	20.7279	20.8888	20.9285	20.9326	20.9317	20.8991	20.6331	20.1815	19.7865
Non living	18.6022	18.8381	19.2923	19.6953	19.8557	19.8891	19.8913	19.8910	19.8706	19.6027	19.0533	18.5414
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	20.4097	20.0250	20.3876	20.7279	20.8888	20.9285	20.9326	20.9317	20.8991	20.6331	20.1815	19.9562 (87)
Th 2	19.9462	19.9581	19.9621	19.9740	19.9740	19.9768	19.9768	19.9768	19.9768	19.9740	19.9768	19.9661 (88)
util rest of house	0.9918	0.9806	0.9297	0.7781	0.5518	0.3314	0.2233	0.2593	0.5352	0.8782	0.9803	0.9948 (89)
MIT 2	19.4104	18.8381	19.2923	19.6953	19.8557	19.8891	19.8913	19.8910	19.8706	19.6027	19.0533	18.7981 (90)
Living area fraction												fLA = Living area / (4) = 0.2394 (91)
MIT	19.6497	19.1223	19.5545	19.9425	20.1031	20.1380	20.1406	20.1402	20.1168	19.8494	19.3234	19.0754 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6497	19.1223	19.5545	19.9425	20.1031	20.1380	20.1406	20.1402	20.1168	19.8494	19.3234	19.0754 (93)

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## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9911	0.9761	0.9226	0.7768	0.5598	0.3421	0.2351	0.2726	0.5469	0.8737	0.9761	0.9934	(94)
Useful gains	1400.2143	1685.8060	2006.8277	2155.1400	1739.3158	1140.3362	736.1863	758.1890	1280.8179	1575.2817	1407.9531	1283.7825	(95)
Ext temp.	4.4000	4.7000	6.7000	9.0000	12.2000	15.1000	16.9000	16.8000	14.3000	10.8000	7.2000	4.0000	(96)
Heat loss rate W	3583.5189	3346.3254	2969.8602	2495.6813	1802.4618	1145.5356	736.8518	759.4938	1322.6339	2063.9181	2756.6266	3468.0710	(97)
Space heating kWh	1624.3786	1115.8690	716.4961	245.1897	46.9806	0.0000	0.0000	0.0000	0.0000	363.5455	971.0449	1625.1106	(98a)
Space heating requirement - total per year (kWh/year)												6708.6151	
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	1624.3786	1115.8690	716.4961	245.1897	46.9806	0.0000	0.0000	0.0000	0.0000	363.5455	971.0449	1625.1106	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6708.6151	
Space heating per m2												33.3248	(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 %)													324.4302	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													65.0000	(208)
Space heating requirement	1624.3786	1115.8690	716.4961	245.1897	46.9806	0.0000	0.0000	0.0000	0.0000	363.5455	971.0449	1625.1106	(98)	
Space heating efficiency (main heating system 1)	324.4302	324.4302	324.4302	324.4302	324.4302	0.0000	0.0000	0.0000	0.0000	324.4302	324.4302	324.4302	(210)	
Space heating fuel (main heating system)	500.6866	343.9473	220.8475	75.5755	14.4810	0.0000	0.0000	0.0000	0.0000	112.0566	299.3078	500.9122	(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 requirement	321.7043	284.5836	302.1021	264.5775	255.8757	229.8741	226.1513	235.3726	238.2654	266.5584	284.5757	318.0128	(64)	
Efficiency of water heater (217)m	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	(216)	
Fuel for water heating, kWh/month	183.2446	162.1005	172.0791	150.7049	145.7483	130.9376	128.8171	134.0696	135.7174	151.8332	162.0960	181.1419	(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	7.7173	6.9705	7.7173	7.4684	7.7173	7.4684	7.7173	7.4684	7.7173	7.4684	7.7173	7.4684	(231)	
Lighting	39.0163	31.3003	28.1825	20.6477	15.9489	13.0304	14.5491	18.9115	24.5641	32.2295	36.4031	40.1007	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)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	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													2067.8146	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.5600	
Water heating fuel used													1838.4902	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: (MEV)Decentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)														
mechanical ventilation fans (SFP = 0.1543)													90.8652	(230a)
Total electricity for the above, kWh/year													90.8652	(231)
Electricity for lighting (calculated in Appendix L)													314.8841	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													0.0000	(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													4312.0540	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2067.8146	25.1600	520.2621	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1838.4902	25.1600	462.5641	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	90.8652	25.1600	22.8617	(249)
Energy for lighting	314.8841	25.1600	79.2248	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1084.9128	(255)



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## 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	2067.8146	0.1573	325.2358 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1838.4902	0.1410	259.1591 (264)
Space and water heating			584.3949 (265)
Pumps, fans and electric keep-hot	90.8652	0.1387	12.6041 (267)
Energy for lighting	314.8841	0.1443	45.4475 (268)
Total CO2, kg/year			642.4465 (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	2067.8146	1.5822	3271.7786 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1838.4902	1.5212	2796.7725 (278)
Space and water heating			6068.5511 (279)
Pumps, fans and electric keep-hot	90.8652	1.5128	137.4609 (281)
Energy for lighting	314.8841	1.5338	482.9797 (282)
Total Primary energy kWh/year			6688.9917 (286)

## SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: B 82  
 Current environmental impact rating: A 96

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 93	-46 kg (7.2%)
U Solar photovoltaic panels	+ 3.8	-£ 262	-140 kg (23.5%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£93	0.23 kg/m <sup>2</sup>	B 84	A 97
Solar photovoltaic panels	£262	0.70 kg/m <sup>2</sup>	B 88	A 97
<b>Total Savings</b>	<b>£356</b>	<b>0.93 kg/m<sup>2</sup></b>		

Potential energy efficiency rating: B 88  
 Potential environmental impact rating: A 97

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, Thames Valley):

	Current	Potential	Saving
Electricity	£1085	£991	£93
Space heating	£543	£564	-£20
Water heating	£463	£349	£114
Lighting	£79	£79	£0
Generated (PV)	-£0	-£262	£262
<b>Total cost of fuels</b>	<b>£1085</b>	<b>£729</b>	<b>£356</b>
<b>Total cost of uses</b>	<b>£1085</b>	<b>£730</b>	<b>£356</b>
Delivered energy	21 kWh/m <sup>2</sup>	14 kWh/m <sup>2</sup>	7 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.6 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m <sup>2</sup>	3 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	33 kWh/m <sup>2</sup>	23 kWh/m <sup>2</sup>	10 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	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 482.7982 (5)

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## 2. Ventilation rate

		m3 per hour												
Number of open chimneys		0 * 80 =	0.0000	(6a)										
Number of open flues		1 * 20 =	20.0000	(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) =		20.0000	/ (5) =	0.0414	(8)							
Pressure test						Yes								
Pressure Test Method						Blower Door								
Measured/design AP50						5.0100	(17)							
Infiltration rate						0.2919	(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) =		0.2481	(21)							
-----														
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(22)	
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000		
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	0.3164	0.3102	0.3040	0.2730	0.2667	0.2357	0.2357	0.2295	0.2481	0.2667	0.2792	0.2916	(22b)	
Mechanical extract ventilation - decentralised														
If mechanical ventilation														
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)														
Effective ac	0.5664	0.5602	0.5540	0.5230	0.5167	0.5000	0.5000	0.5000	0.5000	0.5167	0.5292	0.5416	(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	(27)					
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870			(27)					
Doors			2.3100	1.2000	2.7720			(26)					
Composite Doors			2.1000	1.2000	2.5200			(26a)					
NW Roof Window			1.0200	1.1450	1.1679			(27a)					
Roof Lantern			5.7800	1.1450	6.6183			(27a)					
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500	(28a)					
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000	(28b)					
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000	(29a)					
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400	(29a)					
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100	(30)					
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800	(30)					
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500	(30)					
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200	(30)					
Total net area of external elements Aum(A, m2)			429.4700					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	110.6519			(33)					
Internal Wall 1			210.4500			75.0000	15783.7500	(32c)					
Internal Wall 2			84.0500			9.0000	756.4500	(32c)					
Internal Floor 1			89.9400			18.0000	1618.9200	(32d)					
Internal Ceiling 1			89.9400			9.0000	809.4600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	44933.1300	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							223.2037	(35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E1 Steel lintel with perforated steel base plate				22.2300	0.2300	5.1129							
E3 Sill				14.2300	0.0200	0.2846							
E4 Jamb				49.3000	0.0150	0.7395							
E5 Ground floor (normal)				41.7200	0.0600	2.5032							
E20 Exposed floor (normal)				4.7000	0.3200	1.5040							
E21 Exposed floor (inverted)				2.2700	0.3200	0.7264							
E6 Intermediate floor within a dwelling				33.0700	0.0020	0.0661							
E24 Eaves (insulation at ceiling level - inverted)				8.6500	0.1500	1.2975							
E11 Eaves (insulation at rafter level)				34.2300	0.1500	5.1345							
E12 Gable (insulation at ceiling level)				9.9700	0.0440	0.4387							
E13 Gable (insulation at rafter level)				18.1400	0.2500	4.5350							
E15 Flat roof with parapet				8.6500	0.3000	2.5950							
E16 Corner (normal)				28.1400	0.0450	1.2663							
E17 Corner (inverted - internal area greater than external area)				3.2800	-0.0910	-0.2985							
R1 Head of roof window				2.9600	0.2400	0.7104							
R2 Sill of roof window				2.9600	0.2400	0.7104							
R3 Jamb of roof window				7.8800	0.2400	1.8912							
R5 Ridge (inverted)				10.0300	0.1200	1.2036							
R6 Flat ceiling				51.0400	0.1200	6.1248							
R7 Flat ceiling (inverted)				4.3400	0.1200	0.5208							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.0664	(36)					
Point Thermal bridges							0.0000	(36a)					
Total fabric heat loss						(33) + (36) + (36a) =	147.7183	(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)
	90.2366	89.2483	88.2599	83.3182	82.3298	79.6617	79.6617	79.6617	79.6617	82.3298	84.3065	86.2832	
Heat transfer coeff	237.9549	236.9666	235.9782	231.0365	230.0482	227.3800	227.3800	227.3800	227.3800	230.0482	232.0249	234.0015	(39)
Average = Sum(39)m / 12 =												231.4649	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
	1.1820	1.1771	1.1722	1.1477	1.1428	1.1295	1.1295	1.1295	1.1295	1.1428	1.1526	1.1624	
HLP (average)												1.1498	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 3.0036 (42)

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Hot water usage for mixer showers	119.7957	117.9954	115.3720	110.3526	106.6484	102.5176	100.1696	102.7731	105.6271	110.0624	115.1896	119.3367 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	45.3901	43.7396	42.0890	40.4385	38.7879	37.1374	37.1374	38.7879	40.4385	42.0890	43.7396	45.3901 (42c)
Average daily hot water use (litres/day)												151.7113 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	165.1858	161.7349	157.4610	150.7911	145.4364	139.6550	137.3070	141.5611	146.0656	152.1514	158.9291	164.7268 (44)
Energy content (annual)	261.6139	230.3084	242.0117	206.4255	195.7853	171.7221	166.0609	175.2822	180.1134	206.4680	226.4237	257.9224 (45)
Distribution loss (46)m = 0.15 x (45)m	39.2421	34.5463	36.3018	30.9638	29.3678	25.7583	24.9091	26.2923	27.0170	30.9702	33.9636	38.6884 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1880 (55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (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	321.7043	284.5836	300.7064	257.8239	243.0814	217.2673	213.1243	223.2761	232.8626	265.1627	284.5757	318.0128 (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												645.2842 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												645.2842
Solar input	-0.0000	-16.1753	-59.4954	-82.7910	-109.5653	-101.2521	-100.6471	-87.2123	-59.3017	-28.8440	-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	321.7043	268.4083	241.2110	175.0329	133.5161	116.0153	112.4772	136.0638	173.5608	236.3186	284.5757	318.0128 (64)
Electric shower(s)												2516.8967 (64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	135.0589	119.9977	127.4246	109.7552	102.9355	93.5338	92.8660	96.6765	102.0870	115.6063	121.8075	133.8315 (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	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.5751	39.5912	32.1977	24.3758	18.2212	15.3831	16.6220	21.6058	28.9993	36.8213	42.9759	45.8140 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	555.6547	561.4206	546.8906	515.9579	476.9109	440.2122	415.6953	409.9293	424.4594	455.3921	494.4390	531.1377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	181.5308	178.5680	171.2696	152.4378	138.3541	129.9081	124.8199	129.9415	141.7875	155.3849	169.1770	179.8811 (72)
Total internal gains	897.8585	895.6777	866.4558	808.8693	749.5841	701.6013	673.2350	677.5745	711.3441	763.6961	822.6898	872.9306 (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	16.5500	11.2829	0.7600	1.0000	0.7700	98.3484 (75)						
Southeast	1.6300	36.7938	0.7600	1.0000	0.7700	31.5871 (77)						
Southwest	10.0500	36.7938	0.7600	1.0000	0.7700	194.7547 (79)						
Northwest	2.5000	11.2829	0.7600	1.0000	0.7700	14.8562 (81)						
Northwest	1.0200	17.4137	0.7600	0.7000	1.0000	8.5044 (82)						
Horizontal	5.7800	26.0000	0.7600	0.7000	1.0000	71.9541 (82)						
Solar gains	420.0049	783.1802	1241.4997	1806.6607	2256.6880	2339.7169	2214.6266	1865.7976	1436.2570	912.3667	515.6519	351.1627 (83)
Total gains	1317.8633	1678.8579	2107.9555	2615.5299	3006.2721	3041.3182	2887.8617	2543.3722	2147.6011	1676.0628	1338.3417	1224.0933 (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	52.4529	52.6717	52.8923	54.0236	54.2557	54.8924	54.8924	54.8924	54.8924	54.2557	53.7935	53.3391
alpha	4.4969	4.5114	4.5262	4.6016	4.6170	4.6595	4.6595	4.6595	4.6595	4.6170	4.5862	4.5559
util living area	0.9953	0.9861	0.9540	0.8477	0.6616	0.4703	0.3448	0.4074	0.6757	0.9330	0.9896	0.9966 (86)

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Living	19.7770	19.9941	20.3188	20.6803	20.8672	20.9227	20.9315	20.9293	20.8820	20.5709	20.1036	19.7519
Non living	18.5050	18.7839	19.1922	19.6336	19.8289	19.8857	19.8909	19.8901	19.8582	19.5251	18.9404	18.4852
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	20.3743	19.9941	20.3188	20.6803	20.8672	20.9227	20.9315	20.9293	20.8820	20.5709	20.1036	19.9265 (87)
Th 2	19.9344	19.9383	19.9423	19.9621	19.9661	19.9768	19.9768	19.9768	19.9768	19.9661	19.9581	19.9502 (88)
util rest of house	0.9939	0.9820	0.9411	0.8119	0.6022	0.3985	0.2655	0.3187	0.5946	0.9079	0.9859	0.9956 (89)
MIT 2	19.3646	18.7839	19.1922	19.6336	19.8289	19.8857	19.8909	19.8901	19.8582	19.5251	18.9404	18.7492 (90)
Living area fraction									FLA = Living area / (4) =			0.2394 (91)
MIT	19.6063	19.0737	19.4619	19.8842	20.0775	20.1340	20.1401	20.1389	20.1033	19.7755	19.2189	19.0311 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6063	19.0737	19.4619	19.8842	20.0775	20.1340	20.1401	20.1389	20.1033	19.7755	19.2189	19.0311 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9934	0.9776	0.9339	0.8089	0.6089	0.4097	0.2782	0.3329	0.6052	0.9022	0.9823	0.9944	(94)
Useful gains	1309.1318	1641.2677	1968.6412	2115.5981	1830.4627	1246.1526	803.4335	846.7083	1299.8054	1512.1658	1314.6764	1217.2016	(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	3642.2188	3358.6853	3058.7287	2537.7587	1927.2257	1258.3138	804.9437	850.1451	1365.0356	2110.8119	2811.8801	3470.5009	(97)
Space heating kWh	1735.8167	1154.1046	811.0251	303.9556	71.9917	0.0000	0.0000	0.0000	0.0000	445.3927	1077.9867	1676.4547	(98a)
Space heating requirement - total per year (kWh/year)												7276.7278	
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	1735.8167	1154.1046	811.0251	303.9556	71.9917	0.0000	0.0000	0.0000	0.0000	445.3927	1077.9867	1676.4547	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7276.7278	
Space heating per m2										(98c) / (4) =		36.1469	(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 %)													324.5214	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1735.8167	1154.1046	811.0251	303.9556	71.9917	0.0000	0.0000	0.0000	0.0000	445.3927	1077.9867	1676.4547	(98)	
Space heating efficiency (main heating system 1)	324.5214	324.5214	324.5214	324.5214	324.5214	0.0000	0.0000	0.0000	0.0000	324.5214	324.5214	324.5214	(210)	
Space heating fuel (main heating system)	534.8852	355.6329	249.9142	93.6627	22.1840	0.0000	0.0000	0.0000	0.0000	137.2460	332.1774	516.5930	(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	321.7043	268.4083	241.2110	175.0329	133.5161	116.0153	112.4772	136.0638	173.5608	236.3186	284.5757	318.0128	(64)	
Efficiency of water heater (217)m	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	(216)	
Fuel for water heating, kWh/month	183.2446	152.8869	137.3952	99.6997	76.0515	66.0830	64.0677	77.5027	98.8613	134.6085	162.0960	181.1419	(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	14.5118	13.1075	14.5118	14.0437	14.5118	14.0437	14.5118	14.5118	14.0437	14.5118	14.0437	14.5118	(231)	
Lighting	39.0163	31.3003	28.1825	20.6477	15.9489	13.0304	14.5491	18.9115	24.5641	32.2295	36.4031	40.1007	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-40.9127	-62.0987	-94.3973	-108.5935	-117.3040	-109.4121	-107.8254	-100.1667	-86.6341	-71.6149	-46.1104	-34.7400	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													2242.2955	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.5600	
Water heating fuel used													1433.6390	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(MEV)Decentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)														
mechanical ventilation fans (SFP = 0.1543)													90.8652	(230a)
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													170.8652	(231)
Electricity for lighting (calculated in Appendix L)													314.8841	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-979.8098	(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														

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Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3181.8740 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2242.2955	16.4900	369.7545 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1433.6390	16.4900	236.4071 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	90.8652	16.4900	14.9837 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	314.8841	16.4900	51.9244 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-979.8098	16.4900	-161.5706
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-161.5706 (252)
Total energy cost			524.6910 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.7669 (257)
SAP value		87.5690
SAP rating (Section 12)		88 (258)
SAP band		B

## 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	2242.2955	0.1568	351.6754 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1433.6390	0.1449	207.7403 (264)
Space and water heating			559.4157 (265)
Pumps, fans and electric keep-hot	170.8652	0.1387	23.7011 (267)
Energy for lighting	314.8841	0.1443	45.4475 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-979.8098	0.1340	-131.3114
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-131.3114 (269)
Total CO2, kg/year			497.2530 (272)
CO2 emissions per m2			2.4700 (273)
EI value			97.2948
EI rating			97 (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	108.6100 (1b)	x 2.3200 (2b)	= 251.9752 (1b) - (3b)
First floor	92.7000 (1c)	x 2.4900 (2c)	= 230.8230 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	201.3100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	482.7982 (5)

### 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	1 * 20 = 20.0000 (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) =	20.0000 / (5) = 0.0414 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0100 (17)
Infiltration rate	0.2919 (18)
Number of sides sheltered	2 (19)

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Shelter factor													(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) =	0.2481 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Wind factor	4.8000	4.5000	4.4000	4.1000	4.1000	3.8000	3.8000	3.5000	3.8000	4.1000	4.0000	4.3000	(22)		
Adj infilt rate	1.2000	1.1250	1.1000	1.0250	1.0250	0.9500	0.9500	0.8750	0.9500	1.0250	1.0000	1.0750	(22a)		
Mechanical extract ventilation - decentralised	0.2978	0.2792	0.2730	0.2543	0.2543	0.2357	0.2357	0.2171	0.2357	0.2543	0.2481	0.2667	(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)	
Effective ac	0.5478	0.5292	0.5230	0.5043	0.5043	0.5000	0.5000	0.5000	0.5000	0.5043	0.5000	0.5167	(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	
Glazing (Uw = 1.20)			30.7300	1.1450	35.1870			(27)
Doors			2.3100	1.2000	2.7720			(26)
Composite Doors			2.1000	1.2000	2.5200			(26a)
NW Roof Window			1.0200	1.1450	1.1679			(27a)
Roof Lantern			5.7800	1.1450	6.6183			(27a)
Ground Floor			108.6100	0.1200	13.0332	75.0000	8145.7500	(28a)
Exposed Floor			2.7500	0.3400	0.9350	20.0000	55.0000	(28b)
External Walls	186.4100	35.1400	151.2700	0.2100	31.7667	110.0000	16639.7000	(29a)
Dormer Cheeks	8.1600		8.1600	0.2900	2.3664	9.0000	73.4400	(29a)
Flat Roof	18.6700	5.7800	12.8900	0.1100	1.4179	9.0000	116.0100	(30)
Rafter Roof	55.3400	1.0200	54.3200	0.1300	7.0616	9.0000	488.8800	(30)
Rafter Roof Dormer	7.1500		7.1500	0.1600	1.1440	9.0000	64.3500	(30)
Joisted Roof	42.3800		42.3800	0.1100	4.6618	9.0000	381.4200	(30)
Total net area of external elements Aum(A, m2)			429.4700					(31)
Fabric heat loss, W/K = Sum (A x U)					110.6519			(32)
Internal Wall 1			210.4500			75.0000	15783.7500	(32c)
Internal Wall 2			84.0500			9.0000	756.4500	(32c)
Internal Floor 1			89.9400			18.0000	1618.9200	(32d)
Internal Ceiling 1			89.9400			9.0000	809.4600	(32e)
Heat capacity Cm = Sum(A x k)								(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								(35)
List of Thermal Bridges								
K1 Element				Length	Psi-value		Total	
E1 Steel lintel with perforated steel base plate				22.2300	0.2300		5.1129	
E3 Sill				14.2300	0.0200		0.2846	
E4 Jamb				49.3000	0.0150		0.7395	
E5 Ground floor (normal)				41.7200	0.0600		2.5032	
E20 Exposed floor (normal)				4.7000	0.3200		1.5040	
E21 Exposed floor (inverted)				2.2700	0.3200		0.7264	
E6 Intermediate floor within a dwelling				33.0700	0.0020		0.0661	
E24 Eaves (insulation at ceiling level - inverted)				8.6500	0.1500		1.2975	
E11 Eaves (insulation at rafter level)				34.2300	0.1500		5.1345	
E12 Gable (insulation at ceiling level)				9.9700	0.0440		0.4387	
E13 Gable (insulation at rafter level)				18.1400	0.2500		4.5350	
E15 Flat roof with parapet				8.6500	0.3000		2.5950	
E16 Corner (normal)				28.1400	0.0450		1.2663	
E17 Corner (inverted - internal area greater than external area)				3.2800	-0.0910		-0.2985	
R1 Head of roof window				2.9600	0.2400		0.7104	
R2 Sill of roof window				2.9600	0.2400		0.7104	
R3 Jamb of roof window				7.8800	0.2400		1.8912	
R5 Ridge (inverted)				10.0300	0.1200		1.2036	
R6 Flat ceiling				51.0400	0.1200		6.1248	
R7 Flat ceiling (inverted)				4.3400	0.1200		0.5208	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.0664	(36)
Point Thermal bridges							(36a) =	0.0000
Total fabric heat loss							(33) + (36) + (36a) =	147.7183 (37)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 44933.1300 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 223.2037 (35)

Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	22.2300	0.2300	5.1129
E3 Sill	14.2300	0.0200	0.2846
E4 Jamb	49.3000	0.0150	0.7395
E5 Ground floor (normal)	41.7200	0.0600	2.5032
E20 Exposed floor (normal)	4.7000	0.3200	1.5040
E21 Exposed floor (inverted)	2.2700	0.3200	0.7264
E6 Intermediate floor within a dwelling	33.0700	0.0020	0.0661
E24 Eaves (insulation at ceiling level - inverted)	8.6500	0.1500	1.2975
E11 Eaves (insulation at rafter level)	34.2300	0.1500	5.1345
E12 Gable (insulation at ceiling level)	9.9700	0.0440	0.4387
E13 Gable (insulation at rafter level)	18.1400	0.2500	4.5350
E15 Flat roof with parapet	8.6500	0.3000	2.5950
E16 Corner (normal)	28.1400	0.0450	1.2663
E17 Corner (inverted - internal area greater than external area)	3.2800	-0.0910	-0.2985
R1 Head of roof window	2.9600	0.2400	0.7104
R2 Sill of roof window	2.9600	0.2400	0.7104
R3 Jamb of roof window	7.8800	0.2400	1.8912
R5 Ridge (inverted)	10.0300	0.1200	1.2036
R6 Flat ceiling	51.0400	0.1200	6.1248
R7 Flat ceiling (inverted)	4.3400	0.1200	0.5208

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0664 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 147.7183 (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	87.2716	84.3065	83.3182	80.3531	80.3531	79.6617	79.6617	79.6617	79.6617	80.3531	79.6617	82.3298	(38)		
Average = Sum(39)m / 12 =	234.9899	232.0249	231.0365	228.0715	228.0715	227.3800	227.3800	227.3800	227.3800	228.0715	227.3800	230.0482	(39)		
													229.1012		

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
HLP (average)	1.1673	1.1526	1.1477	1.1329	1.1329	1.1295	1.1295	1.1295	1.1295	1.1329	1.1295	1.1428	(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													3.0036 (42)	
Hot water usage for mixer showers													119.3367 (42a)	
Hot water usage for baths													0.0000 (42b)	
Hot water usage for other uses													45.3901 (42c)	
Average daily hot water use (litres/day)													151.7113 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte	165.1858	161.7349	157.4610	150.7911	145.4364	139.6550	137.3070	141.5611	146.0656	152.1514	158.9291	164.7268	(44)	
Energy content (annual)	261.6139	230.3084	242.0117	206.4255	195.7853	171.7221	166.0609	175.2822	180.1134	206.4680	226.4237	257.9224	(45)	
Distribution loss (46)m = 0.15 x (45)m													2520.1373	
Water storage loss:													38.6884 (46)	
Store volume													300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):													2.2000 (48)	
Temperature factor from Table 2b													0.5400 (49)	
Enter (49) or (54) in (55)													1.1880 (55)	
Total storage loss													36.8280 (56)	
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280		

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If cylinder contains dedicated solar storage												
Primary loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280 (57)
Combi 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)
Total heat required for water heating calculated for each month	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)
WWHRS	321.7043	284.5836	300.7064	257.8239	243.0814	217.2673	213.1243	223.2761	232.8626	265.1627	284.5757	318.0128 (62)
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 (63a)
Aperture area of solar collector	-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)
Zero-loss collector efficiency												0.8000 (H1)
Collector linear heat loss coefficient												0.8000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector loop efficiency												0.0000 (H4)
Incidence angle modifier												0.9000 (H5)
Overshading factor												1.0000 (H6)
Overall heat loss coefficient of system												0.8000 (H8)
Heat loss coefficient of collector loop												6.5000 (H10)
Dedicated solar storage volume												3.9667 (H11)
Effective solar volume												75.0000 (H12)
Reference volume												75.0000 (H14)
Storage tank correction coefficient												225.0000 (H15)
Heat delivered to hot water												1.3161 (H16)
Heat delivered to space heating												729.0720 (H24)
Solar input												0.0000 (H29)
Solar input	-0.8020	-19.0939	-63.9766	-90.9524	-113.6394	-114.3454	-111.7566	-99.6972	-70.8531	-38.8007	-5.1547	-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	320.9023	265.4897	236.7298	166.8714	129.4420	102.9219	101.3678	123.5789	162.0094	226.3620	279.4210	318.0128 (64)
Electric shower(s)												2433.1089 (64)
	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												0.0000 (64a)
	135.0589	119.9977	127.4246	109.7552	102.9355	93.5338	92.8660	96.6765	102.0870	115.6063	121.8075	133.8315 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175	180.2175 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.5751	39.5912	32.1977	24.3758	18.2212	15.3831	16.6220	21.6058	28.9993	36.8213	42.9759	45.8140 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	555.6547	561.4206	546.8906	515.9579	476.9109	440.2122	415.6953	409.9293	424.4594	455.3921	494.4390	531.1377 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254	56.0254 (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)	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450	-120.1450 (71)
Water heating gains (Table 5)	181.5308	178.5680	171.2696	152.4378	138.3541	129.9081	124.8199	129.9415	141.7875	155.3849	169.1770	179.8811 (72)
Total internal gains	897.8585	895.6777	866.4558	808.8693	749.5841	701.6013	673.2350	677.5745	711.3441	763.6961	822.6898	872.9306 (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			16.5500	14.1923	0.7600	1.0000	0.7700	123.7076 (75)				
Southeast			1.6300	43.9597	0.7600	1.0000	0.7700	37.7389 (77)				
Southwest			10.0500	43.9597	0.7600	1.0000	0.7700	232.6843 (79)				
Northwest			2.5000	14.1923	0.7600	1.0000	0.7700	18.6869 (81)				
Northwest			1.0200	22.0723	0.7600	0.7000	1.0000	10.7796 (82)				
Horizontal			5.7800	33.0000	0.7600	0.7000	1.0000	91.3263 (82)				
Solar gains	514.9236	831.3903	1307.1281	1957.9735	2343.5203	2617.3782	2444.2174	2090.8313	1624.7472	1037.8864	619.7823	419.3863 (83)
Total gains	1412.7821	1727.0679	2173.5839	2766.8428	3093.1043	3318.9795	3117.4524	2768.4059	2336.0913	1801.5825	1442.4722	1292.3169 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	53.1147	53.7935	54.0236	54.7259	54.7259	54.8924	54.8924	54.8924	54.8924	54.7259	54.8924	54.2557 (85)
alpha	4.5410	4.5862	4.6016	4.6484	4.6484	4.6595	4.6595	4.6595	4.6595	4.6484	4.6595	4.6170
util living area	0.9936	0.9849	0.9449	0.8184	0.6155	0.4006	0.2983	0.3434	0.6182	0.9100	0.9854	0.9960 (86)
Living	19.8460	20.0250	20.3871	20.7266	20.8882	20.9284	20.9326	20.9317	20.8988	20.6327	20.1815	19.7865
Non living	18.6022	18.8381	19.2917	19.6939	19.8552	19.8891	19.8913	19.8910	19.8704	19.6023	19.0533	18.5414
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	20.4097	20.0250	20.3871	20.7266	20.8882	20.9284	20.9326	20.9317	20.8988	20.6327	20.1815	19.9562 (87)
Th 2	19.9462	19.9581	19.9621	19.9740	19.9740	19.9768	19.9768	19.9768	19.9768	19.9740	19.9768	19.9661 (88)
util rest of house	0.9918	0.9806	0.9299	0.7794	0.5540	0.3328	0.2243	0.2606	0.5364	0.8785	0.9803	0.9948 (89)
MIT 2	19.4104	18.8381	19.2917	19.6939	19.8552	19.8891	19.8913	19.8910	19.8704	19.6023	19.0533	18.7981 (90)
Living area fraction										FLA = Living area / (4) =		0.2394 (91)
MIT	19.6497	19.1223	19.5539	19.9412	20.1025	20.1379	20.1406	20.1402	20.1166	19.8490	19.3234	19.0754 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6497	19.1223	19.5539	19.9412	20.1025	20.1379	20.1406	20.1402	20.1166	19.8490	19.3234	19.0754 (93)

## 8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9911	0.9761	0.9228	0.7780	0.5620	0.3435	0.2361	0.2739	0.5481	0.8739	0.9761	0.9934	(94)
Useful gains	1400.2143	1685.8060	2005.7739	2152.5853	1738.2102	1140.2326	736.1712	758.1585	1280.3878	1574.4456	1407.9531	1283.7825	(95)
Ext temp.	4.4000	4.7000	6.7000	9.0000	12.2000	15.1000	16.9000	16.8000	14.3000	10.8000	7.2000	4.0000	(96)
Heat loss rate W	3583.5189	3346.3254	2969.7274	2495.3739	1802.3344	1145.5233	736.8498	759.4898	1322.5837	2063.8147	2756.6266	3468.0710	(97)
Space heating kWh	1624.3786	1115.8690	717.1814	246.8078	47.7084	0.0000	0.0000	0.0000	0.0000	364.0906	971.0449	1625.1106	(98a)
Space heating requirement - total per year (kWh/year)												6712.1914	
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	1624.3786	1115.8690	717.1814	246.8078	47.7084	0.0000	0.0000	0.0000	0.0000	364.0906	971.0449	1625.1106	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6712.1914	
Space heating per m2												33.3426	(99)

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

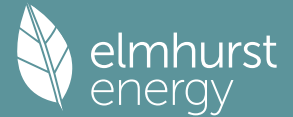
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)	
Fraction of space heat from main system(s)														1.0000	(202)
Efficiency of main space heating system 1 (in %)														324.4302	(206)
Efficiency of main space heating system 2 (in %)														0.0000	(207)
Efficiency of secondary/supplementary heating system, %														65.0000	(208)
Space heating requirement	1624.3786	1115.8690	717.1814	246.8078	47.7084	0.0000	0.0000	0.0000	0.0000	364.0906	971.0449	1625.1106		(98)	
Space heating efficiency (main heating system 1)	324.4302	324.4302	324.4302	324.4302	324.4302	0.0000	0.0000	0.0000	0.0000	324.4302	324.4302	324.4302		(210)	
Space heating fuel (main heating system)	500.6866	343.9473	221.0588	76.0742	14.7053	0.0000	0.0000	0.0000	0.0000	112.2246	299.3078	500.9122		(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 requirement	320.9023	265.4897	236.7298	166.8714	129.4420	102.9219	101.3678	123.5789	162.0094	226.3620	279.4210	318.0128		(64)	
Efficiency of water heater (217)m	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600	175.5600		(216)	
Fuel for water heating, kWh/month	182.7878	151.2245	134.8427	95.0509	73.7309	58.6249	57.7397	70.3913	92.2815	128.9371	159.1598	181.1419		(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	14.5118	13.1075	14.5118	14.0437	14.5118	14.0437	14.5118	14.5118	14.0437	14.5118	14.0437	14.5118		(231)	
Lighting	39.0163	31.3003	28.1825	20.6477	15.9489	13.0304	14.5491	18.9115	24.5641	32.2295	36.4031	40.1007		(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-48.8162	-64.9057	-96.8230	-112.7593	-118.4468	-115.5219	-113.0170	-106.2522	-93.2137	-78.0734	-53.6265	-40.6640		(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(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													2068.9169	(211)	
Space heating fuel - main system 2													0.0000	(213)	
Space heating fuel - secondary													0.0000	(215)	
Efficiency of water heater													175.5600		
Water heating fuel used													1385.9130	(219)	
Space cooling fuel													0.0000	(221)	
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)															
mechanical ventilation fans (SFP = 0.1543)														90.8652	(230a)
pump for solar water heating														80.0000	(230g)
Total electricity for the above, kWh/year														170.8652	(231)
Electricity for lighting (calculated in Appendix L)														314.8841	(232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation														-1042.1196	(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														2898.4596	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2068.9169	25.1600	520.5395	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1385.9130	25.1600	348.6957	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	90.8652	25.1600	22.8617	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	314.8841	25.1600	79.2248	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1042.1196	25.1600	-262.1973	



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PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-262.1973 (252)
Total energy cost			729.2524 (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	2068.9169	0.1573	325.3919 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1385.9130	0.1455	201.6270 (264)
Space and water heating			527.0189 (265)
Pumps, fans and electric keep-hot	170.8652	0.1387	23.7011 (267)
Energy for lighting	314.8841	0.1443	45.4475 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1042.1196	0.1343	-139.9391
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-139.9391 (269)
Total CO2, kg/year			456.2285 (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	2068.9169	1.5822	3273.4592 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1385.9130	1.5381	2131.7400 (278)
Space and water heating			5405.1992 (279)
Pumps, fans and electric keep-hot	170.8652	1.5128	258.4849 (281)
Energy for lighting	314.8841	1.5338	482.9797 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1042.1196	1.4963	-1559.2884
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1559.2884 (283)
Total Primary energy kWh/year			4587.3754 (286)