

# Full SAP Calculation Printout



Property Reference	D3ARCH-7054-23		Issued on Date	15/10/2023	
Assessment Reference	DS SEC1 R WALL	Prop Type Ref	DS		
Property	Proposed Dwelling, The Workshop, Carnon Crescent, Carnon Downs, Cornwall, TR3 6HL				
SAP Rating	102 A	DER	-1.51	TER	17.69
Environmental	101 A	% DER < TER			108.54
CO <sub>2</sub> Emissions (t/year)	-0.16	DFEE	47.76	TFEE	53.64
Compliance Check	See BREL	% DFEE < TFEE			10.97
% DPER < TPER	101.67	DPER	-1.56	TPER	93.59
Assessor Details	Mr. Stuart Thomas			Assessor ID	V220-0003
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	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	156.6875 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour											
Number of open chimneys	0 * 80 =	0.0000 (6a)										
Number of open flues	0 * 20 =	0.0000 (6b)										
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)										
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)										
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)										
Number of blocked chimneys	0 * 20 =	0.0000 (6f)										
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)										
Number of passive vents	0 * 10 =	0.0000 (7b)										
Number of flueless gas fires	0 * 40 =	0.0000 (7c)										
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)										
Pressure test		Yes										
Pressure Test Method		Blower Door										
Measured/design AP50		2.5000 (17)										
Infiltration rate		0.1250 (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) =	0.1062 (21)										
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)



## 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	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.0297	98.5686	89.0297	91.9973	89.0297	91.9973	89.0297	89.0297	91.9973	89.0297	91.9973	89.0297 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	159.5669	161.2227	157.0501	148.1672	136.9541	126.4154	119.3749	117.7191	121.8917	130.7746	141.9877	152.5264 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)	125.8128	123.9849	120.5706	113.2322	108.7044	103.9852	101.1510	103.5909	106.4390	111.6747	118.7170	124.8859 (72)
Total internal gains	424.8643	434.2310	417.1052	403.8516	385.1431	372.8527	360.0104	360.7945	370.7829	381.9338	403.1568	416.8968 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W						
East	1.0400	19.6403	0.7600	0.7000	0.7700	7.5305 (76)						
South	2.3800	46.7521	0.7600	0.7000	0.7700	41.0225 (78)						
East	1.0800	26.0000	0.7600	0.7000	1.0000	13.4447 (82)						
West	1.6200	26.0000	0.7600	0.7000	1.0000	20.1671 (82)						
Solar gains	82.1648	151.7247	233.9463	326.0214	392.3658	399.9411	381.3668	331.3038	266.2826	175.2667	100.6765	68.7880 (83)
Total gains	507.0291	585.9557	651.0515	729.8730	777.5089	772.7938	741.3772	692.0984	637.0655	557.2005	503.8333	485.6848 (84)

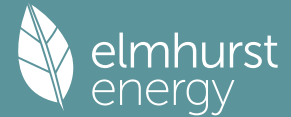
## 7. Mean internal temperature (heating season)

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, n <sub>l,m</sub> (see Table 9a)	23.3012	23.3546	23.4082	23.6800	23.7352	24.0147	24.0147	24.0714	23.9021	23.7352	23.6252	23.5162
tau	2.5534	2.5570	2.5605	2.5787	2.5823	2.6010	2.6010	2.6048	2.5935	2.5823	2.5750	2.5677
util living area	0.9051	0.8680	0.8131	0.7134	0.5873	0.4424	0.3314	0.3660	0.5460	0.7547	0.8677	0.9129 (86)
Living	19.2513	19.5133	19.8677	20.2948	20.6042	20.7875	20.8495	20.8392	20.7116	20.2998	19.7183	19.2090
Non living	17.9666	18.2921	18.7291	19.2483	19.6031	19.8044	19.8597	19.8546	19.7311	19.2696	18.5613	17.9199
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	20.1054	19.5133	19.8677	20.2948	20.6042	20.7875	20.8495	20.8392	20.7116	20.2998	19.7183	19.4596 (87)
Th 2	20.0029	20.0049	20.0070	20.0173	20.0193	20.0296	20.0296	20.0317	20.0255	20.0193	20.0152	20.0111 (88)
util rest of house	0.8936	0.8528	0.7918	0.6820	0.5434	0.3850	0.2632	0.2955	0.4870	0.7199	0.8500	0.9023 (89)
MIT 2	19.1911	18.2921	18.7291	19.2483	19.6031	19.8044	19.8597	19.8546	19.7311	19.2696	18.5613	18.2967 (90)
Living area fraction	19.6788	18.9435	19.3364	19.8065	20.1371	20.3288	20.3877	20.3798	20.2541	19.8191	19.1785	18.9170 (92)
MIT	19.6788	18.9435	19.3364	19.8065	20.1371	20.3288	20.3877	20.3798	20.2541	19.8191	19.1785	18.9170 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6788	18.9435	19.3364	19.8065	20.1371	20.3288	20.3877	20.3798	20.2541	19.8191	19.1785	18.9170 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8895	0.8339	0.7756	0.6747	0.5489	0.4032	0.2888	0.3214	0.5015	0.7121	0.8324	0.8885 (94)
Useful gains	450.9847	488.6529	504.9830	492.4607	426.7995	311.5556	214.1360	222.4619	319.4870	396.7872	419.3846	431.5267 (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	924.2454	842.0667	767.9244	644.9804	497.7878	334.0627	220.8695	231.5292	360.5544	543.9260	715.9440	876.3860 (97)
Space heating kWh	352.1059	237.4941	195.6284	109.8142	52.8153	0.0000	0.0000	0.0000	0.0000	109.4713	213.5228	330.9753 (98a)
Space heating requirement - total per year (kWh/year)												1601.8272
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	352.1059	237.4941	195.6284	109.8142	52.8153	0.0000	0.0000	0.0000	0.0000	109.4713	213.5228	330.9753 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1601.8272
Space heating per m <sup>2</sup>												(98c) / (4) = 29.2518 (99)

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## 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 %)												401.0395 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	352.1059	237.4941	195.6284	109.8142	52.8153	0.0000	0.0000	0.0000	0.0000	109.4713	213.5228	330.9753 (98)
Space heating efficiency (main heating system 1)	401.0395	401.0395	401.0395	401.0395	401.0395	0.0000	0.0000	0.0000	0.0000	401.0395	401.0395	401.0395 (210)
Space heating fuel (main heating system)	87.7983	59.2196	48.7803	27.3824	13.1696	0.0000	0.0000	0.0000	0.0000	27.2969	53.2423	82.5294 (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	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706 (64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (216)
Fuel for water heating, kWh/month	100.8720	89.3051	95.1406	84.3071	82.1671	74.5232	73.9087	76.5763	77.1196	85.4145	90.1103	99.8586 (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	12.1441	10.9688	12.1441	11.7523	12.1441	11.7523	12.1441	12.1441	11.7523	12.1441	11.7523	12.1441 (231)
Lighting	18.5301	14.8656	13.3848	9.8063	7.5746	6.1886	6.9098	8.9817	11.6663	15.3068	17.2890	19.0451 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-51.6665	-86.1170	-144.1152	-175.8994	-191.7940	-174.5045	-172.1534	-162.2276	-138.3528	-105.5310	-60.5235	-42.6711 (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	-5.3453	-17.9901	-55.0425	-119.4656	-195.4252	-214.7577	-208.3885	-155.8189	-90.4402	-33.6865	-8.9177	-3.7859 (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												399.4188 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												204.6600
Water heating fuel used												1029.3030 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.7000, SFP = 0.7480)												
mechanical ventilation fans (SFP = 0.7480)												142.9867 (230a)
Total electricity for the above, kWh/year												142.9867 (231)
Electricity for lighting (calculated in Appendix L)												149.5488 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2614.6202 (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												-893.3628 (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	399.4188	0.1555	62.1080 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1029.3030	0.1407	144.8212 (264)
Space and water heating			206.9292 (265)
Pumps, fans and electric keep-hot	142.9867	0.1387	19.8340 (267)
Energy for lighting	149.5488	0.1443	21.5845 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1505.5562	0.1330	-200.2652
PV Unit electricity exported	-1109.0640	0.1180	-130.8636
Total			-331.1288 (269)
Total CO2, kg/year			-82.7811 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-1.5100 (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	399.4188	1.5756	629.3388 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1029.3030	1.5202	1564.7889 (278)
Space and water heating			2194.1277 (279)
Pumps, fans and electric keep-hot	142.9867	1.5128	216.3103 (281)
Energy for lighting	149.5488	1.5338	229.3830 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1505.5562	1.4915	-2245.6075
PV Unit electricity exported	-1109.0640	0.4327	-479.8612
Total			-2725.4687 (283)
Total Primary energy kWh/year			-85.6477 (286)
Dwelling Primary energy Rate (DPER)			-1.5600 (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	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 156.6875 (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	2 * 10 = 20.0000 (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)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1276 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3776 (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) = 0.3210 (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	0.4093	0.4012	0.3932	0.3531	0.3451	0.3049	0.3049	0.2969	0.3210	0.3451	0.3611	0.3772 (22b)
Effective ac	0.5838	0.5805	0.5773	0.5623	0.5595	0.5465	0.5465	0.5441	0.5515	0.5595	0.5652	0.5711 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Semi-glazed door			3.7800	1.0000	3.7800		(26a)
TER Opening Type (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
5-6			1.0800	1.5918	1.7191		(27a)
9-11			1.6200	1.5918	2.5787		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215		(28a)

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External Wall 1 Render	96.8600	7.0000	89.8600	0.1800	16.1748	(29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1800	2.8422	(29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1100	3.8357	(30)
Total net area of external elements Aum(A, m2)			175.9700			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.1680	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 92.0623 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	21.6000	0.1600	3.4560
E16 Corner (normal)	21.5400	0.0900	1.9386
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466
E11 Eaves (insulation at rafter level)	14.6000	0.0400	0.5840
E13 Gable (insulation at rafter level)	10.6200	0.0800	0.8496
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.0800	0.5840
E6 Intermediate floor within a dwelling	9.8500	0.0000	0.0000
E2 Other lintels (including other steel lintels)	6.0500	0.0500	0.3025
E3 Sill	4.2500	0.0500	0.2125
E4 Jamb	16.3000	0.0500	0.8150
R1 Head of roof window	2.7500	0.0800	0.2200
R2 Sill of roof window	2.7500	0.0600	0.1650
R3 Jamb of roof window	9.8000	0.0800	0.7840

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.4326 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 52.6006 (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	30.1839	30.0158	29.8510	29.0768	28.9319	28.2576	28.2576	28.1327	28.5173	28.9319	29.2249	29.5313 (38)
Average = Sum(39)m / 12 =	82.7845	82.6164	82.4515	81.6773	81.5325	80.8582	80.8582	80.7333	81.1179	81.5325	81.8255	82.1319 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.5118	1.5087	1.5057	1.4916	1.4889	1.4766	1.4766	1.4743	1.4813	1.4889	1.4943	1.4999 (40)
HLP (average)												1.4915
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

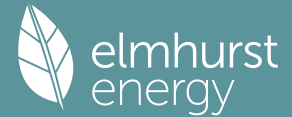
Assumed occupancy 1.8303 (42)

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	0.0000 (42a)
Hot water usage for baths	63.2632	62.3237	61.0006	58.5611	56.7344	54.7089	53.6148	54.9287	56.3592	58.5265	61.0163	63.0494 (42b)	
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)	
Average daily hot water use (litres/day)												88.9953 (43)	
Daily hot water use	96.6376	94.4844	91.9477	88.2946	85.2543	82.0152	80.9211	83.4486	86.0927	89.4737	93.1770	96.4237 (44)	
Energy content (annual)	153.0503	134.5446	141.3203	120.8709	114.7687	100.8472	97.8671	103.3267	106.1609	121.4149	132.7478	150.9762 (45)	
Distribution loss (46)m = 0.15 x (45)m	22.9575	20.1817	21.1980	18.1306	17.2153	15.1271	14.6801	15.4990	15.9241	18.2122	19.9122	22.6464 (46)	
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.9188 (55)	
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)	
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (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	204.7969	181.2834	193.0668	170.9482	166.5153	150.9246	149.6137	155.0733	156.2382	173.1615	182.8251	202.7228 (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	204.7969	181.2834	193.0668	170.9482	166.5153	150.9246	149.6137	155.0733	156.2382	173.1615	182.8251	202.7228 (64)	
												Total per year (kWh/year) = Sum(64)m = 2087.1700 (64)	
12Total per year (kWh/year)												2087 (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	92.2865	82.1272	88.3863	80.2515	79.5579	73.5936	73.9381	75.7534	75.3604	81.7677	84.2005	91.5969 (65)	

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

Metabolic gains (Table 5), Watts

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.0297	98.5686	89.0297	91.9973	89.0297	91.9973	89.0297	89.0297	91.9973	89.0297	91.9973	89.0297	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	159.5669	161.2227	157.0501	148.1672	136.9541	126.4154	119.3749	117.7191	121.8917	130.7746	141.9877	152.5264	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	(71)
Water heating gains (Table 5)	124.0410	122.2130	118.7987	111.4603	106.9326	102.2133	99.3791	101.8191	104.6672	109.9029	116.9451	123.1141	(72)
Total internal gains	426.0924	435.4592	418.3334	405.0797	386.3713	371.0809	358.2385	359.0227	369.0110	383.1620	404.3850	418.1250	(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							
East	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424 (76)							
South	2.3800	46.7521	0.6300	0.7000	0.7700	34.0055 (78)							
East	1.0800	26.0000	0.6300	0.7000	1.0000	11.1450 (82)							
West	1.6200	26.0000	0.6300	0.7000	1.0000	16.7174 (82)							
Solar gains	68.1103	125.7718	193.9292	270.2546	325.2506	331.5301	316.1330	274.6334	220.7343	145.2869	83.4555	57.0216	(83)
Total gains	494.2028	561.2310	612.2626	675.3343	711.6218	702.6110	674.3715	633.6561	589.7453	528.4489	487.8405	475.1466	(84)

## 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	16.9158	16.9503	16.9842	17.1451	17.1756	17.3188	17.3188	17.3456	17.2634	17.1756	17.1141	17.0503	
alpha	2.1277	2.1300	2.1323	2.1430	2.1450	2.1546	2.1546	2.1564	2.1509	2.1450	2.1409	2.1367	
util living area	0.9250	0.9014	0.8665	0.7993	0.7034	0.5743	0.4551	0.4920	0.6646	0.8235	0.8997	0.9303	(86)
MIT	17.8022	18.1488	18.6973	19.4400	20.1029	20.6016	20.8292	20.7915	20.4145	19.5630	18.5727	17.7468	(87)
Th 2	19.6787	19.6810	19.6832	19.6938	19.6958	19.7051	19.7051	19.7068	19.7015	19.6958	19.6918	19.6876	(88)
util rest of house	0.9138	0.8869	0.8461	0.7670	0.6517	0.4928	0.3432	0.3809	0.5903	0.7880	0.8825	0.9200	(89)
MIT 2	16.0508	16.4829	17.1652	18.0766	18.8582	19.4075	19.6174	19.5921	19.2273	18.2482	17.0267	15.9850	(90)
Living area fraction									fLA = Living area / (4) =			0.5334	(91)
MIT	16.9850	17.3715	17.9824	18.8039	19.5221	20.0444	20.2638	20.2319	19.8606	18.9495	17.8513	16.9248	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9850	17.3715	17.9824	18.8039	19.5221	20.0444	20.2638	20.2319	19.8606	18.9495	17.8513	16.9248	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8824	0.8533	0.8127	0.7409	0.6440	0.5158	0.3941	0.4288	0.6005	0.7633	0.8505	0.8895	(94)
Useful gains	436.0741	478.8759	497.5860	500.3658	458.2618	362.3728	265.7408	271.7096	354.1166	403.3799	414.8963	422.6255	(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	1050.1224	1030.3521	946.7455	808.9244	637.7576	440.2265	296.2450	309.3618	467.2877	680.7586	879.7328	1045.1103	(97)
Space heating kWh	456.8519	370.5920	334.1746	222.1622	133.5449	0.0000	0.0000	0.0000	0.0000	206.3698	334.6823	463.1287	(98a)
Space heating requirement - total per year (kWh/year)												2521.5064	
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	456.8519	370.5920	334.1746	222.1622	133.5449	0.0000	0.0000	0.0000	0.0000	206.3698	334.6823	463.1287	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2521.5064	
Space heating per m2												46.0465	(99)

## 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	456.8519	370.5920	334.1746	222.1622	133.5449	0.0000	0.0000	0.0000	0.0000	206.3698	334.6823	463.1287	(98)

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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	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	494.9642	401.5081	362.0527	240.6958	144.6856	0.0000	0.0000	0.0000	0.0000	0.0000	223.5859	362.6027	501.7646	(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	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	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	0.0000	(215)
Water heating														
Water heating requirement	204.7969	181.2834	193.0668	170.9482	166.5153	150.9246	149.6137	155.0733	156.2382	173.1615	182.8251	202.7228	202.7228	(64)
Efficiency of water heater	85.8047	85.6277	85.2781	84.6485	83.5696	79.8000	79.8000	79.8000	79.8000	84.4542	85.3975	79.8000	79.8000	(216)
Fuel for water heating, kWh/month	238.6781	211.7111	226.3967	201.9508	199.2534	189.1286	187.4858	194.3275	195.7873	205.0359	214.0873	236.1304	236.1304	(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	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	18.4986	14.8403	13.3620	9.7896	7.5618	6.1780	6.8981	8.9664	11.6465	15.2808	17.2596	19.0127	19.0127	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-24.6713	-35.1783	-51.1437	-58.2030	-63.3878	-59.4339	-58.7524	-55.1935	-48.9559	-40.6020	-27.2840	-21.2876	-21.2876	(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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-12.7390	-26.9349	-53.7746	-81.0964	-107.5250	-108.1059	-106.7832	-90.2315	-65.9319	-38.5692	-17.0289	-10.0591	-10.0591	(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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1														2731.8596 (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														2499.9727 (219)
Space cooling fuel														0.0000 (221)
Electricity for pumps and fans:														
Total electricity for the above, kWh/year														86.0000 (231)
Electricity for lighting (calculated in Appendix L)														149.2944 (232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation														-1262.8728 (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														4204.2539 (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	2731.8596	0.2100	573.6905 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2499.9727	0.2100	524.9943 (264)
Space and water heating			1098.6848 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	149.2944	0.1443	21.5478 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.0932	0.1343	-73.0846
PV Unit electricity exported	-718.7795	0.1258	-90.4129
Total			-163.4975 (269)
Total CO2, kg/year			968.6643 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.6900 (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	2731.8596	1.1300	3087.0013 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2499.9727	1.1300	2824.9692 (278)
Space and water heating			5911.9705 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	149.2944	1.5338	228.9927 (282)



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Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.0932	1.4964	-814.1936
PV Unit electricity exported	-718.7795	0.4617	-331.8745
Total			-1146.0681 (283)
Total Primary energy kWh/year			5124.9959 (286)
Target Primary Energy Rate (TPER)			93.5900 (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	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 156.6875 (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	2 * 10 =	20.0000 (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) =	0.1276 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	2.5000	(17)
Infiltration rate	0.2526	(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) =	0.2147 (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	0.2738	0.2684	0.2631	0.2362	0.2309	0.2040	0.2040	0.1986	0.2147	0.2309	0.2416	0.2523 (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	0.5375	0.5360	0.5346	0.5279	0.5266	0.5208	0.5208	0.5197	0.5231	0.5266	0.5292	0.5318 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)
5-6			1.0800	1.2357	1.3346		(27a)
9-11			1.6200	1.2357	2.0019		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215	110.0000	2810.5000 (28a)
External Wall 1 Render	96.8600	7.0000	89.8600	0.1000	8.9860	9.0000	808.7400 (29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1000	1.5790	9.0000	142.1100 (29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1500	5.2305	9.0000	313.8300 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.9055		(33)
Internal Wall 1			40.6600			9.0000	365.9400 (32c)
Internal Floor 1			22.2300			18.0000	400.1400 (32d)
Internal Ceiling 1			22.2300			9.0000	200.0700 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	5041.3300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							92.0623 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	21.6000	0.0640	1.3824
E16 Corner (normal)	21.5400	0.0420	0.9047
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0790	0.2165
E11 Eaves (insulation at rafter level)	14.6000	0.1500	2.1900
E13 Gable (insulation at rafter level)	10.6200	0.2500	2.6550
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.1200	0.8760
E6 Intermediate floor within a dwelling	9.8500	0.0490	0.4827
E2 Other lintels (including other steel lintels)	6.0500	0.0140	0.0847
E3 Sill	4.2500	0.0460	0.1955
E4 Jamb	16.3000	0.0050	0.0815
R1 Head of roof window	2.7500	0.2400	0.6600
R2 Sill of roof window	2.7500	0.2400	0.6600
R3 Jamb of roof window	9.8000	0.2400	2.3520

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.5089 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 48.4144 (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	27.7916	27.7163	27.6426	27.2961	27.2312	26.9294	26.9294	26.8736	27.0457	27.2312	27.3624	27.4995 (38)
Average = Sum(39)m / 12 =	76.2060	76.1308	76.0570	75.7105	75.6457	75.3439	75.3439	75.2880	75.4601	75.6457	75.7768	75.9139 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3916	1.3903	1.3889	1.3826	1.3814	1.3759	1.3759	1.3749	1.3780	1.3814	1.3838	1.3863 (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													1.8303 (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	0.0000 (42a)
Hot water usage for baths	23.7355	23.3830	22.8866	21.9713	21.2860	20.5260	20.1155	20.6085	21.1452	21.9583	22.8925	23.6552 (42b)	
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)	
Average daily hot water use (litres/day)													52.3468 (43)
Daily hot water use	57.1098	55.5437	53.8337	51.7048	49.8058	47.8323	47.4218	49.1284	50.8787	52.9055	55.0532	57.0296 (44)	
Energy content (annual)	90.4480	79.0935	82.7404	70.7813	67.0482	58.8154	57.3526	60.8312	62.7385	71.7922	78.4334	89.2946 (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	76.8808	67.2295	70.3293	60.1641	56.9910	49.9931	48.7497	51.7065	53.3277	61.0234	66.6684	75.9004 (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	76.8808	67.2295	70.3293	60.1641	56.9910	49.9931	48.7497	51.7065	53.3277	61.0234	66.6684	75.9004 (64)	
12Total per year (kWh/year)													738.9638 (64)
Electric shower(s)	43.9722	39.1796	42.7826	40.8269	41.5930	39.6757	40.9982	41.5930	40.8269	42.7826	41.9781	43.9722 (64a)	
Heat gains from water heating, kWh/month	30.2132	26.6023	28.2780	25.2478	24.6460	22.4172	22.4370	23.3249	23.5387	25.9515	27.1616	29.9681 (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	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.0297	98.5686	89.0297	91.9973	89.0297	91.9973	89.0297	89.0297	91.9973	89.0297	91.9973	89.0297 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	159.5669	161.2227	157.0501	148.1672	136.9541	126.4154	119.3749	117.7191	121.8917	130.7746	141.9877	152.5264 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)												

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Total internal gains	40.6092	39.5867	38.0080	35.0663	33.1264	31.1350	30.1572	31.3506	32.6926	34.8810	37.7245	40.2798 (72)
	339.6606	349.8328	334.5427	325.6857	309.5650	300.0026	289.0166	288.5542	297.0364	305.1401	322.1643	332.2907 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
East	1.0400	19.6403	0.7600	0.7000	0.7700	7.5305 (76)	
South	2.3800	46.7521	0.7600	0.7000	0.7700	41.0225 (78)	
East	1.0800	26.0000	0.7600	0.7000	1.0000	13.4447 (82)	
West	1.6200	26.0000	0.7600	0.7000	1.0000	20.1671 (82)	

Solar gains	82.1648	151.7247	233.9463	326.0214	392.3658	399.9411	381.3668	331.3038	266.2826	175.2667	100.6765	68.7880 (83)
Total gains	421.8255	501.5575	568.4890	651.7071	701.9308	699.9437	670.3834	619.8581	563.3191	480.4069	422.8408	401.0786 (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	18.3761	18.3943	18.4121	18.4964	18.5122	18.5864	18.5864	18.6002	18.5577	18.5122	18.4802	18.4468
alpha	2.2251	2.2263	2.2275	2.2331	2.2341	2.2391	2.2391	2.2400	2.2372	2.2341	2.2320	2.2298
util living area	0.9410	0.9144	0.8745	0.7979	0.6916	0.5562	0.4370	0.4798	0.6635	0.8377	0.9176	0.9468 (86)
MIT	17.8523	18.2414	18.8208	19.5718	20.2134	20.6642	20.8606	20.8232	20.4694	19.6140	18.6023	17.7748 (87)
Th 2	19.7698	19.7708	19.7718	19.7767	19.7776	19.7819	19.7819	19.7827	19.7802	19.7776	19.7758	19.7739 (88)
util rest of house	0.9323	0.9020	0.8558	0.7669	0.6417	0.4792	0.3338	0.3759	0.5928	0.8056	0.9035	0.9388 (89)
MIT 2	16.9458	17.3263	17.8905	18.6095	19.1983	19.5830	19.7241	19.7043	19.4382	18.6694	17.6909	16.8724 (90)
Living area fraction	17.4293	17.8144	18.3867	19.1228	19.7398	20.1598	20.3304	20.3012	19.9883	19.1733	18.1770	17.3538 (92)
MIT	17.4293	17.8144	18.3867	19.1228	19.7398	20.1598	20.3304	20.3012	19.9883	19.1733	18.1770	17.3538 (92)
Temperature adjustment												0.0000
adjusted MIT	17.4293	17.8144	18.3867	19.1228	19.7398	20.1598	20.3304	20.3012	19.9883	19.1733	18.1770	17.3538 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9098	0.8764	0.8299	0.7477	0.6400	0.5045	0.3823	0.4225	0.6060	0.7865	0.8794	0.9174 (94)
Useful gains	383.7717	439.5865	471.7694	487.2645	449.2475	353.1446	256.2694	261.8764	341.3714	377.8448	371.8656	367.9420 (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	1000.5315	983.1851	904.0698	773.9745	608.1771	418.8945	281.0598	293.7102	444.3300	648.5313	839.3827	998.5532 (97)
Space heating kWh	458.8693	365.2982	321.6315	206.4312	118.2436	0.0000	0.0000	0.0000	0.0000	201.3907	336.6123	469.1747 (98a)
Space heating requirement - total per year (kWh/year)												2477.6516
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	458.8693	365.2982	321.6315	206.4312	118.2436	0.0000	0.0000	0.0000	0.0000	201.3907	336.6123	469.1747 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2477.6516
Space heating per m2												(98c) / (4) = 45.2456 (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	708.2324	557.5446	572.1887	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7044	0.7680	0.7368	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	498.8637	428.1785	421.5970	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	735.8352	705.6671	655.3820	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	170.6195	206.4515	173.9361	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	42.6549	51.6129	43.4840	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												137.7518 (107)
Energy for space heating												45.2456 (99)
Energy for space cooling												2.5156 (108)
Total												47.7612 (109)
Fabric Energy Efficiency (DFEE)												47.8 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 156.6875 (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	2 * 10 = 20.0000 (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) = 0.1276 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3776 (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) = 0.3210 (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	0.4093	0.4012	0.3932	0.3531	0.3451	0.3049	0.3049	0.2969	0.3210	0.3451	0.3611	0.3772 (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	0.5838	0.5805	0.5773	0.5623	0.5595	0.5465	0.5465	0.5441	0.5515	0.5595	0.5652	0.5711 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Semi-glazed door			3.7800	1.0000	3.7800		(26a)
TER Opening Type (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
5-6			1.0800	1.5918	1.7191		(27a)
9-11			1.6200	1.5918	2.5787		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215		(28a)
External Wall 1 Render	96.8600	7.0000	89.8600	0.1800	16.1748		(29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1800	2.8422		(29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1100	3.8357		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 38.1680		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K

92.0623 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	21.6000	0.1600	3.4560
E16 Corner (normal)	21.5400	0.0900	1.9386
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466
E11 Eaves (insulation at rafter level)	14.6000	0.0400	0.5840
E13 Gable (insulation at rafter level)	10.6200	0.0800	0.8496
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.0800	0.5840
E6 Intermediate floor within a dwelling	9.8500	0.0000	0.0000
E2 Other lintels (including other steel lintels)	6.0500	0.0500	0.3025

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E3 Sill		4.2500	0.0500	0.2125
E4 Jamb		16.3000	0.0500	0.8150
R1 Head of roof window		2.7500	0.0800	0.2200
R2 Sill of roof window		2.7500	0.0600	0.1650
R3 Jamb of roof window		9.8000	0.0800	0.7840
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				14.4326 (36)
Point Thermal bridges				0.0000
Total fabric heat loss			(33) + (36) + (36a) =	52.6006 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	30.1839	30.0158	29.8510	29.0768	28.9319	28.2576	28.2576	28.1327	28.5173	28.9319	29.2249	29.5313 (38)
Heat transfer coeff	82.7845	82.6164	82.4515	81.6773	81.5325	80.8582	80.8582	80.7333	81.1179	81.5325	81.8255	82.1319 (39)
Average = Sum(39)m / 12 =												81.6766

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.5118	1.5087	1.5057	1.4916	1.4889	1.4766	1.4766	1.4743	1.4813	1.4889	1.4943	1.4999 (40)
HLP (average)												1.4915
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8303 (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	0.0000 (42a)
Hot water usage for baths	23.7355	23.3830	22.8866	21.9713	21.2860	20.5260	20.1155	20.6085	21.1452	21.9583	22.8925	23.6552 (42b)	
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)	
Average daily hot water use (litres/day)													52.3468 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	57.1098	55.5437	53.8337	51.7048	49.8058	47.8323	47.4218	49.1284	50.8787	52.9055	55.0532	57.0296 (44)	
Energy conte	90.4480	79.0935	82.7404	70.7813	67.0482	58.8154	57.3526	60.8312	62.7385	71.7922	78.4334	89.2946 (45)	
Energy content (annual)													Total = Sum(45)m = 869.3692
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	76.8808	67.2295	70.3293	60.1641	56.9910	49.9931	48.7497	51.7065	53.3277	61.0234	66.6684	75.9004 (62)	
MWHRs	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	76.8808	67.2295	70.3293	60.1641	56.9910	49.9931	48.7497	51.7065	53.3277	61.0234	66.6684	75.9004 (64)	
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 739 (64)
Electric shower(s)	43.9722	39.1796	42.7826	40.8269	41.5930	39.6757	40.9982	41.5930	40.8269	42.7826	41.9781	43.9722 (64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													500.1811 (64a)
Heat gains from water heating, kWh/month	30.2132	26.6023	28.2780	25.2478	24.6460	22.4172	22.4370	23.3249	23.5387	25.9515	27.1616	29.9681 (65)	

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

Metabolic gains (Table 5), Watts													
(66)m	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162	91.5162 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.0297	98.5686	89.0297	91.9973	89.0297	91.9973	89.0297	89.0297	91.9973	89.0297	91.9973	89.0297 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	159.5669	161.2227	157.0501	148.1672	136.9541	126.4154	119.3749	117.7191	121.8917	130.7746	141.9877	152.5264 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516	32.1516 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)	
Water heating gains (Table 5)	40.6092	39.5867	38.0080	35.0663	33.1264	31.1350	30.1572	31.3506	32.6926	34.8810	37.7245	40.2798 (72)	
Total internal gains	339.6606	349.8328	334.5427	325.6857	309.5650	300.0026	289.0166	288.5542	297.0364	305.1401	322.1643	332.2907 (73)	

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Factor Table 6d	W
East	1.0400	19.6403	0.6300	0.7000	0.7700	6.2424 (76)
South	2.3800	46.7521	0.6300	0.7000	0.7700	34.0055 (78)
East	1.0800	26.0000	0.6300	0.7000	1.0000	11.1450 (82)
West	1.6200	26.0000	0.6300	0.7000	1.0000	16.7174 (82)

Solar gains	68.1103	125.7718	193.9292	270.2546	325.2506	331.5301	316.1330	274.6334	220.7343	145.2869	83.4555	57.0216 (83)
Total gains	407.7710	475.6046	528.4719	595.9403	634.8156	631.5327	605.1496	563.1877	517.7707	450.4270	405.6198	389.3123 (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	16.9158	16.9503	16.9842	17.1451	17.1756	17.3188	17.3188	17.3456	17.2634	17.1756	17.1141	17.0503	
alpha	2.1277	2.1300	2.1323	2.1430	2.1450	2.1546	2.1546	2.1564	2.1509	2.1450	2.1409	2.1367	
util living area	0.9463	0.9251	0.8939	0.8313	0.7403	0.6129	0.4930	0.5343	0.7088	0.8602	0.9264	0.9510 (86)	
MIT	17.5560	17.9209	18.4961	19.2856	19.9962	20.5441	20.7993	20.7535	20.3274	19.3969	18.3531	17.4977 (87)	
Th 2	19.6787	19.6810	19.6832	19.6938	19.6958	19.7051	19.7051	19.7068	19.7015	19.6958	19.6918	19.6876 (88)	
util rest of house	0.9379	0.9136	0.8767	0.8023	0.6911	0.5310	0.3760	0.4190	0.6371	0.8298	0.9129	0.9433 (89)	
MIT 2	16.6008	16.9598	17.5238	18.2903	18.9535	19.4344	19.6228	19.5983	19.2670	18.4152	17.3980	16.5489 (90)	
Living area fraction	fLA = Living area / (4) =												
MIT	17.1103	17.4725	18.0425	18.8212	19.5097	20.0263	20.2504	20.2145	19.8326	18.9389	17.9075	17.0550 (92)	
Temperature adjustment	0.0000												
adjusted MIT	17.1103	17.4725	18.0425	18.8212	19.5097	20.0263	20.2504	20.2145	19.8326	18.9389	17.9075	17.0550 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9152	0.8876	0.8493	0.7789	0.6831	0.5531	0.4284	0.4676	0.6453	0.8078	0.8883	0.9217 (94)
Useful gains	373.1884	422.1301	448.8104	464.1732	433.6260	349.2954	259.2402	263.3522	334.1048	363.8604	360.3140	358.8235 (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	1060.4949	1038.6927	951.6928	810.3357	636.7462	438.7633	295.1614	307.9602	465.0186	679.8888	884.3269	1055.8065 (97)
Space heating kWh	511.3560	414.3301	374.1445	249.2370	151.1214	0.0000	0.0000	0.0000	0.0000	235.1252	377.2893	518.5554 (98a)
Space heating requirement - total per year (kWh/year)												2831.1588
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	511.3560	414.3301	374.1445	249.2370	151.1214	0.0000	0.0000	0.0000	0.0000	235.1252	377.2893	518.5554 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2831.1588
Space heating per m2												(98c) / (4) = 51.7012 (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	760.0670	598.3506	613.5732	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6355	0.7038	0.6726	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	482.9920	421.1377	412.7039	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	663.3410	636.4759	595.0053	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	129.8513	160.2116	135.6323	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											
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	32.4628	40.0529	33.9081	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												106.4238 (107)
Energy for space heating												51.7012 (99)
Energy for space cooling												1.9435 (108)
Total												53.6447 (109)
Fabric Energy Efficiency (TFEE)												53.6 (109)

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 156.6875 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour											
Number of open chimneys	0 * 80 =	0.0000 (6a)										
Number of open flues	0 * 20 =	0.0000 (6b)										
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)										
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)										
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)										
Number of blocked chimneys	0 * 20 =	0.0000 (6f)										
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)										
Number of passive vents	0 * 10 =	0.0000 (7b)										
Number of flueless gas fires	0 * 40 =	0.0000 (7c)										
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) =	0.0000 (8)										
Pressure test		Yes										
Pressure Test Method		Blower Door										
Measured/design AP50		2.5000 (17)										
Infiltration rate		0.1250 (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) =	0.1062 (21)										
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (25)

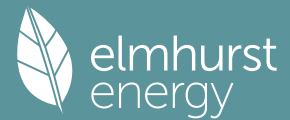
## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)
5-6			1.0800	1.2357	1.3346		(27a)
9-11			1.6200	1.2357	2.0019		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215	110.0000	2810.5000 (28a)
External Wall 1 Render	96.8600	7.0000	89.8600	0.1000	8.9860	9.0000	808.7400 (29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1000	1.5790	9.0000	142.1100 (29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1500	5.2305	9.0000	313.8300 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	30.9055	(33)
Internal Wall 1			40.6600			9.0000	365.9400 (32c)
Internal Floor 1			22.2300			18.0000	400.1400 (32d)
Internal Ceiling 1			22.2300			9.0000	200.0700 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 5041.3300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							92.0623 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	21.6000	0.0640	1.3824
E16 Corner (normal)	21.5400	0.0420	0.9047
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0790	0.2165
E11 Eaves (insulation at rafter level)	14.6000	0.1500	2.1900
E13 Gable (insulation at rafter level)	10.6200	0.2500	2.6550
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.1200	0.8760
E6 Intermediate floor within a dwelling	9.8500	0.0490	0.4827
E2 Other lintels (including other steel lintels)	6.0500	0.0140	0.0847
E3 Sill	4.2500	0.0460	0.1955
E4 Jamb	16.3000	0.0050	0.0815
R1 Head of roof window	2.7500	0.2400	0.6600
R2 Sill of roof window	2.7500	0.2400	0.6600

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R3 Jamb of roof window  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8000 0.2400 2.3520  
 Point Thermal bridges 17.5089 (36)  
 Total fabric heat loss (33) + (36) + (36a) = 48.4144 (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	11.6841	11.5468	11.4094	10.7227	10.5854	9.8986	9.8986	9.7613	10.1733	10.5854	10.8601	11.1348 (38)
Average = Sum(39)m / 12 =	60.0986	59.9612	59.8239	59.1371	58.9998	58.3131	58.3131	58.1757	58.5878	58.9998	59.2745	59.5492 (39)
HLP	1.0975	1.0950	1.0925	1.0799	1.0774	1.0649	1.0649	1.0624	1.0699	1.0774	1.0824	1.0875 (40)
HLP (average)												1.0793
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 1.8303 (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	63.2632	62.3237	61.0006	58.5611	56.7344	54.7089	53.6148	54.9287	56.3592	58.5265	61.0163	63.0494 (42b)
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)
Average daily hot water use (litres/day)												88.9953 (43)
Daily hot water use	96.6376	94.4844	91.9477	88.2946	85.2543	82.0152	80.9211	83.4486	86.0927	89.4737	93.1770	96.4237 (44)
Energy content (annual)	153.0503	134.5446	141.3203	120.8709	114.7687	100.8472	97.8671	103.3267	106.1609	121.4149	132.7478	150.9762 (45)
Distribution loss (46)m = 0.15 x (45)m	22.9575	20.1817	21.1980	18.1306	17.2153	15.1271	14.6801	15.4990	15.9241	18.2122	19.9122	22.6464 (46)
Water storage loss:												210.0000 (47)
Store volume												1.8000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9720 (55)
Enter (49) or (54) in (55)												
Total storage loss	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (56)
If cylinder contains dedicated solar storage	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (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	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706 (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	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706 (64)
Total per year (kWh/year) = Sum(64)m =												2106.5716 (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	93.6048	83.3178	89.7045	81.5272	80.8761	74.8693	75.2563	77.0717	76.6361	83.0860	85.4762	92.9151 (65)

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

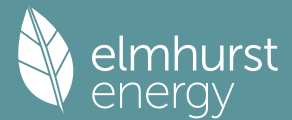
Metabolic gains (Table 5), Watts												
(66)m	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1702	18.8032	15.2918	11.5768	8.6538	7.3059	7.8943	10.2613	13.7727	17.4876	20.4107	21.7586 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	238.1595	240.6309	234.4032	221.1451	204.4091	188.6797	178.1715	175.7001	181.9278	195.1859	211.9219	227.6513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)	125.8128	123.9849	120.5706	113.2322	108.7044	103.9852	101.1510	103.5909	106.4390	111.6747	118.7170	124.8859 (72)
Total internal gains	469.5613	467.8377	454.6843	430.3729	406.1861	384.3895	371.6355	373.9711	386.5583	408.7670	435.4683	458.7145 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	Specific data	g	Specific data	FF	Specific data	Access factor	Gains W
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	W/m2	or Table 6b		or Table 6c		Table 6d	
East	1.0400	19.6403	0.7600	0.7000	0.7700	7.5305	(76)
South	2.3800	46.7521	0.7600	0.7000	0.7700	41.0225	(78)
East	1.0800	26.0000	0.7600	0.7000	1.0000	13.4447	(82)
West	1.6200	26.0000	0.7600	0.7000	1.0000	20.1671	(82)

Solar gains	82.1648	151.7247	233.9463	326.0214	392.3658	399.9411	381.3668	331.3038	266.2826	175.2667	100.6765	68.7880	(83)
Total gains	551.7261	619.5624	688.6305	756.3942	798.5519	784.3306	753.0023	705.2749	652.8410	584.0338	536.1447	527.5025	(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	23.3012	23.3546	23.4082	23.6800	23.7352	24.0147	24.0147	24.0714	23.9021	23.7352	23.6252	23.5162		
alpha	2.5534	2.5570	2.5605	2.5787	2.5823	2.6010	2.6010	2.6048	2.5935	2.5823	2.5750	2.5677		
util living area	0.8890	0.8548	0.7963	0.7003	0.5768	0.4370	0.3268	0.3600	0.5364	0.7384	0.8528	0.8982	(86)	
Living	19.3459	19.5761	19.9247	20.3220	20.6160	20.7902	20.8506	20.8409	20.7187	20.3322	19.7786	19.3004		
Non living	18.0829	18.3682	18.7963	19.2785	19.6151	19.8066	19.8603	19.8557	19.7375	19.3055	18.6336	18.0326		
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	20.1538	19.5761	19.9247	20.3220	20.6160	20.7902	20.8506	20.8409	20.7187	20.3322	19.7786	19.5381	(87)	
Th 2	20.0029	20.0049	20.0070	20.0173	20.0193	20.0296	20.0296	20.0317	20.0255	20.0193	20.0152	20.0111	(88)	
util rest of house	0.8761	0.8385	0.7740	0.6684	0.5330	0.3800	0.2593	0.2904	0.4778	0.7027	0.8337	0.8863	(89)	
MIT 2	19.2374	18.3682	18.7963	19.2785	19.6151	19.8066	19.8603	19.8557	19.7375	19.3055	18.6336	18.3891	(90)	
Living area fraction									fLA = Living area / (4) =				0.5334	(91)
MIT	19.7263	19.0125	19.3982	19.8351	20.1490	20.3313	20.3885	20.3812	20.2608	19.8532	19.2443	19.0020	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.7263	19.0125	19.3982	19.8351	20.1490	20.3313	20.3885	20.3812	20.2608	19.8532	19.2443	19.0020	(93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8722	0.8199	0.7587	0.6621	0.5390	0.3982	0.2847	0.3160	0.4926	0.6961	0.8165	0.8721	(94)
Useful gains	481.2116	507.9681	522.4923	500.7994	430.4333	312.3385	214.4119	222.8985	321.5609	406.5639	437.7593	460.0155	(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	927.0956	846.2023	771.6205	646.6707	498.4905	334.2078	220.9211	231.6106	360.9502	545.9346	719.8496	881.4481	(97)
Space heating kWh	331.7377	227.2934	185.3514	105.0273	50.6346	0.0000	0.0000	0.0000	0.0000	103.6918	203.1050	313.5458	(98a)
Space heating requirement - total per year (kWh/year)												1520.3871	
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	331.7377	227.2934	185.3514	105.0273	50.6346	0.0000	0.0000	0.0000	0.0000	103.6918	203.1050	313.5458	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1520.3871	
Space heating per m2										(98c) / (4) =		27.7646	(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 %) 401.0395 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	331.7377	227.2934	185.3514	105.0273	50.6346	0.0000	0.0000	0.0000	0.0000	103.6918	203.1050	313.5458	(98)
Space heating efficiency (main heating system 1)	401.0395	401.0395	401.0395	401.0395	401.0395	0.0000	0.0000	0.0000	0.0000	401.0395	401.0395	401.0395	(210)
Space heating fuel (main heating system)	82.7195	56.6761	46.2177	26.1888	12.6258	0.0000	0.0000	0.0000	0.0000	25.8558	50.6446	78.1833	(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	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706	(64)
Efficiency of water heater	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	(216)
(217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	(217)
Fuel for water heating, kWh/month	100.8720	89.3051	95.1406	84.3071	82.1671	74.5232	73.9087	76.5763	77.1196	85.4145	90.1103	99.8586	(219)
Space cooling fuel requirement													

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(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	0.0000	(221)
Pumps and Fa	12.1441	10.9688	12.1441	11.7523	12.1441	11.7523	12.1441	12.1441	11.7523	12.1441	11.7523	12.1441	11.7523	(231)
Lighting	18.5301	14.8656	13.3848	9.8063	7.5746	6.1886	6.9098	8.9817	11.6663	15.3068	17.2890	19.0451	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-51.6122	-86.0147	-143.8290	-175.5957	-191.5719	-174.5045	-172.1534	-162.2276	-138.3528	-105.4107	-60.4687	-42.6369	(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	-5.3996	-18.0923	-55.3287	-119.7693	-195.6473	-214.7577	-208.3885	-155.8189	-90.4402	-33.8068	-8.9725	-3.8201	(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													379.1116	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													204.6600	
Water heating fuel used													1029.3030	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.7000, SFP = 0.7480)														
mechanical ventilation fans (SFP = 0.7480)													142.9867	(230a)
Total electricity for the above, kWh/year													142.9867	(231)
Electricity for lighting (calculated in Appendix L)													149.5488	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2614.6202	(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													-913.6700	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	379.1116	16.4900	62.5155 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1029.3030	16.4900	169.7321 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	142.9867	16.4900	23.5785 (249)
Energy for lighting	149.5488	16.4900	24.6606 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1504.3783	16.4900	-248.0720
PV Unit electricity exported	-1110.2419	5.5900	-62.0625
Total			-310.1345 (252)
Total energy cost			-29.6478 (255)

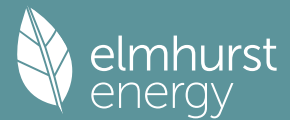
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.1070 (257)
SAP value		101.7343
SAP rating (Section 12)		102 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	379.1116	0.1555	58.9420 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1029.3030	0.1407	144.8212 (264)
Space and water heating			203.7632 (265)
Pumps, fans and electric keep-hot	142.9867	0.1387	19.8340 (267)
Energy for lighting	149.5488	0.1443	21.5845 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1504.3783	0.1330	-200.0932
PV Unit electricity exported	-1110.2419	0.1180	-131.0515
Total			-331.1447 (269)
Total CO2, kg/year			-85.9630 (272)

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CO2 emissions per m2 -1.5700 (273)  
 EI value 101.1547  
 EI rating 101 (274)  
 EI band A

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

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 156.6875 (5)

## 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	Air changes per hour 0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	2.5000 (17)
Infiltration rate	0.1250 (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) = 0.1062 (21)
Wind speed	Jan 5.8000 Feb 5.5000 Mar 5.5000 Apr 5.0000 May 4.9000 Jun 4.3000 Jul 4.3000 Aug 4.1000 Sep 4.5000 Oct 5.1000 Nov 5.1000 Dec 5.7000 (22)
Wind factor	Jan 1.4500 Feb 1.3750 Mar 1.3750 Apr 1.2500 May 1.2250 Jun 1.0750 Jul 1.0750 Aug 1.0250 Sep 1.1250 Oct 1.2750 Nov 1.2750 Dec 1.4250 (22a)
Adj infilt rate	0.1541 0.1461 0.1461 0.1328 0.1302 0.1142 0.1142 0.1089 0.1195 0.1355 0.1355 0.1514 (22b)
Balanced mechanical ventilation with heat recovery	
If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.9000 (23c)
Effective ac	0.2446 0.2366 0.2366 0.2233 0.2207 0.2047 0.2047 0.1994 0.2100 0.2260 0.2260 0.2419 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)
5-6			1.0800	1.2357	1.3346		(27a)
9-11			1.6200	1.2357	2.0019		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215	110.0000	2810.5000 (28a)
External Wall 1 Render	96.8600	7.0000	89.8600	0.1000	8.9860	9.0000	808.7400 (29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1000	1.5790	9.0000	142.1100 (29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1500	5.2305	9.0000	313.8300 (30)
Total net area of external elements Aum(A, m2)			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 30.9055		(33)
Internal Wall 1			40.6600			9.0000	365.9400 (32c)
Internal Floor 1			22.2300			18.0000	400.1400 (32d)
Internal Ceiling 1			22.2300			9.0000	200.0700 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 5041.3300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							92.0623 (35)

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## List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	21.6000	0.0640	1.3824
E16 Corner (normal)	21.5400	0.0420	0.9047
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0790	0.2165
E11 Eaves (insulation at rafter level)	14.6000	0.1500	2.1900
E13 Gable (insulation at rafter level)	10.6200	0.2500	2.6550
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.1200	0.8760
E6 Intermediate floor within a dwelling	9.8500	0.0490	0.4827
E2 Other lintels (including other steel lintels)	6.0500	0.0140	0.0847
E3 Sill	4.2500	0.0460	0.1955
E4 Jamb	16.3000	0.0050	0.0815
R1 Head of roof window	2.7500	0.2400	0.6600
R2 Sill of roof window	2.7500	0.2400	0.6600
R3 Jamb of roof window	9.8000	0.2400	2.3520
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			17.5089 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss		(33) + (36) + (36a) =	48.4144 (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	12.6456	12.2335	12.2335	11.5468	11.4094	10.5854	10.5854	10.3107	10.8601	11.6841	11.6841	12.5082 (38)
Average = Sum(39)m / 12 =	61.0600	60.6479	60.6479	59.9612	59.8239	58.9998	58.9998	58.7251	59.2745	60.0986	60.0986	60.9226 (39)
HLP	1.1150	1.1075	1.1075	1.0950	1.0925	1.0774	1.0774	1.0724	1.0824	1.0975	1.0975	1.1125 (40)
HLP (average)												1.0946
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

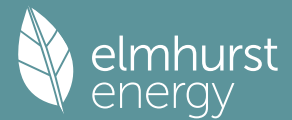
## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8303 (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	0.0000 (42a)
Hot water usage for baths	63.2632	62.3237	61.0006	58.5611	56.7344	54.7089	53.6148	54.9287	56.3592	58.5265	61.0163	63.0494	63.0494 (42b)
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743	33.3743 (42c)
Average daily hot water use (litres/day)													88.9953 (43)
Daily hot water use	96.6376	94.4844	91.9477	88.2946	85.2543	82.0152	80.9211	83.4486	86.0927	89.4737	93.1770	96.4237	96.4237 (44)
Energy content (annual)	153.0503	134.5446	141.3203	120.8709	114.7687	100.8472	97.8671	103.3267	106.1609	121.4149	132.7478	150.9762	150.9762 (45)
Distribution loss (46)m = 0.15 x (45)m	22.9575	20.1817	21.1980	18.1306	17.2153	15.1271	14.6801	15.4990	15.9241	18.2122	19.9122	22.6464	22.6464 (46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.8000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9720 (55)
Total storage loss	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320 (56)
If cylinder contains dedicated solar storage	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320 (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	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	0.0000 (61)
Total heat required for water heating calculated for each month	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706	204.3706 (62)
WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706	204.3706 (64)
Total per year (kWh/year) = Sum(64)m =													2106.5716 (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	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	93.6048	83.3178	89.7045	81.5272	80.8761	74.8693	75.2563	77.0717	76.6361	83.0860	85.4762	92.9151	92.9151 (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	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1702	18.8032	15.2918	11.5768	8.6538	7.3059	7.8943	10.2613	13.7727	17.4876	20.4107	21.7586	21.7586 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	238.1595	240.6309	234.4032	221.1451	204.4091	188.6797	178.1715	175.7001	181.9278	195.1859	211.9219	227.6513	227.6513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123 (69)

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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	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)	125.8128	123.9849	120.5706	113.2322	108.7044	103.9852	101.1510	103.5909	106.4390	111.6747	118.7170	124.8859	(72)
Total internal gains	469.5613	467.8377	454.6843	430.3729	406.1861	384.3895	371.6355	373.9711	386.5583	408.7670	435.4683	458.7145	(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						
East		1.0400	26.5119	0.7600	0.7000	0.7700	10.1653 (76)						
South		2.3800	58.6702	0.7600	0.7000	0.7700	51.4801 (78)						
East		1.0800	36.0000	0.7600	0.7000	1.0000	18.6157 (82)						
West		1.6200	36.0000	0.7600	0.7000	1.0000	27.9236 (82)						
Solar gains	108.1848	171.7876	263.1404	372.9819	423.8978	471.4569	411.4264	384.1195	316.1904	208.6719	127.7946	90.2446	(83)
Total gains	577.7461	639.6252	717.8246	803.3548	830.0840	855.8464	783.0619	758.0906	702.7487	617.4389	563.2629	548.9592	(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	22.9343	23.0901	23.0901	23.3546	23.4082	23.7352	23.7352	23.8462	23.6252	23.3012	23.3012	22.9860	
alpha	2.5290	2.5393	2.5393	2.5570	2.5605	2.5823	2.5823	2.5897	2.5750	2.5534	2.5534	2.5324	
util living area	0.8517	0.8183	0.7604	0.6751	0.5700	0.4258	0.3573	0.3663	0.5001	0.6779	0.8007	0.8572 (86)	
Living	19.6744	19.8371	20.0847	20.3679	20.6132	20.7885	20.8356	20.8337	20.7439	20.4785	20.0723	19.6880	
Non living	18.4826	18.6836	18.9802	19.3198	19.5998	19.7932	19.8376	19.8406	19.7511	19.4594	18.9837	18.5031	
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	20.3219	19.8371	20.0847	20.3679	20.6132	20.7885	20.8356	20.8337	20.7439	20.4785	20.0723	19.8715 (87)	
Th 2	19.9886	19.9947	19.9947	20.0049	20.0070	20.0193	20.0193	20.0234	20.0152	20.0029	20.0029	19.9906 (88)	
util rest of house	0.8334	0.7970	0.7338	0.6416	0.5263	0.3719	0.2930	0.3010	0.4409	0.6339	0.7735	0.8388 (89)	
MIT 2	19.3882	18.6836	18.9802	19.3198	19.5998	19.7932	19.8376	19.8406	19.7511	19.4594	18.9837	18.7712 (90)	
Living area fraction									fLA = Living area / (4) =			0.5334 (91)	
MIT	19.8863	19.2989	19.5693	19.8789	20.1404	20.3241	20.3700	20.3703	20.2807	20.0030	19.5644	19.3581 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.8863	19.2989	19.5693	19.8789	20.1404	20.3241	20.3700	20.3703	20.2807	20.0030	19.5644	19.3581 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8314	0.7805	0.7215	0.6371	0.5324	0.3891	0.3165	0.3247	0.4575	0.6339	0.7601	0.8257 (94)
Useful gains	480.3194	499.2053	517.8893	511.8310	441.9754	332.9720	247.8225	246.1600	321.4791	391.4145	428.1585	453.2661 (95)
Ext temp.	6.3000	6.6000	7.6000	9.1000	11.6000	14.3000	16.0000	16.0000	14.3000	11.8000	9.0000	6.7000 (96)
Heat loss rate W	829.5763	770.1624	725.9150	646.3156	510.9200	355.4203	257.8266	256.6469	354.5009	492.9893	634.9041	771.1654 (97)
Space heating kWh	259.8471	182.0832	154.7711	96.8289	51.2947	0.0000	0.0000	0.0000	0.0000	75.5717	148.8568	236.5171 (98a)
Space heating requirement - total per year (kWh/year)												1205.7707
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	259.8471	182.0832	154.7711	96.8289	51.2947	0.0000	0.0000	0.0000	0.0000	75.5717	148.8568	236.5171 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1205.7707
Space heating per m2										(98c) / (4) =		22.0192 (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 %)												401.2475 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	259.8471	182.0832	154.7711	96.8289	51.2947	0.0000	0.0000	0.0000	0.0000	75.5717	148.8568	236.5171 (98)
Space heating efficiency (main heating system 1)	401.2475	401.2475	401.2475	401.2475	401.2475	0.0000	0.0000	0.0000	0.0000	401.2475	401.2475	401.2475 (210)
Space heating fuel (main heating system)												

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64.7598	45.3793	38.5725	24.1320	12.7838	0.0000	0.0000	0.0000	0.0000	18.8342	37.0985	58.9454	(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													
206.4447	182.7718	194.7147	172.5429	168.1631	152.5192	151.2615	156.7211	157.8329	174.8093	184.4198	204.3706	(64)	
Efficiency of water heater													
(217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	(216)	
Fuel for water heating, kWh/month													
100.8720	89.3051	95.1406	84.3071	82.1671	74.5232	73.9087	76.5763	77.1196	85.4145	90.1103	99.8586	(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	(221)	
Pumps and Fa													
12.1441	10.9688	12.1441	11.7523	12.1441	11.7523	12.1441	11.7523	12.1441	11.7523	12.1441	11.7523	(231)	
Lighting													
18.5301	14.8656	13.3848	9.8063	7.5746	6.1886	6.9098	8.9817	11.6663	15.3068	17.2890	19.0451	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-68.1325	-97.5507	-158.4439	-189.8719	-198.3289	-182.6141	-176.7115	-172.8087	-153.6947	-122.1395	-76.3469	-56.3677	(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	(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	(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	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-9.8723	-24.6515	-72.3889	-155.3767	-226.2748	-281.8033	-239.2987	-202.8414	-125.3275	-49.3703	-15.2048	-6.9871	(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	(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	(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	(235d)	
Annual totals kWh/year													
Space heating fuel - main system 1											300.5055	(211)	
Space heating fuel - main system 2											0.0000	(213)	
Space heating fuel - secondary											0.0000	(215)	
Efficiency of water heater											204.6600		
Water heating fuel used											1029.3030	(219)	
Space cooling fuel											0.0000	(221)	
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.7000, SFP = 0.7480)													
mechanical ventilation fans (SFP = 0.7480)											142.9867	(230a)	
Total electricity for the above, kWh/year											142.9867	(231)	
Electricity for lighting (calculated in Appendix L)											149.5488	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation											-3062.4084	(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											-1440.0644	(238)	

## 10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	300.5055	21.5100	64.6387 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1029.3030	21.5100	221.4031 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	142.9867	21.5100	30.7564 (249)
Energy for lighting	149.5488	21.5100	32.1679 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1653.0111	21.5100	-355.5627
PV Unit electricity exported	-1409.3973	5.5900	-78.7853
Total			-434.3480 (252)
Total energy cost			-85.3818 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	300.5055	0.1552	46.6279 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1029.3030	0.1407	144.8212 (264)
Space and water heating			191.4491 (265)
Pumps, fans and electric keep-hot	142.9867	0.1387	19.8340 (267)
Energy for lighting	149.5488	0.1443	21.5845 (268)

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Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1653.0111	0.1338	-221.2480
PV Unit electricity exported	-1409.3973	0.1189	-167.5450
Total			-388.7930 (269)
Total CO2, kg/year			-155.9254 (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	300.5055	1.5744	473.1220 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1029.3030	1.5202	1564.7889 (278)
Space and water heating			2037.9110 (279)
Pumps, fans and electric keep-hot	142.9867	1.5128	216.3103 (281)
Energy for lighting	149.5488	1.5338	229.3830 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1653.0111	1.4946	-2470.6583
PV Unit electricity exported	-1409.3973	0.4360	-614.5083
Total			-3085.1666 (283)
Total Primary energy kWh/year			-601.5623 (286)

## SAP 10 EPC IMPROVEMENTS

### DS SEC1 R WALL

Current energy efficiency rating:	A 102
Current environmental impact rating:	A 101

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.6	-£ 41	-36 kg (22.9%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£41	0.65 kg/m <sup>2</sup>	A 103	A 102
<b>Total Savings</b>	<b>£41</b>	<b>0.65 kg/m<sup>2</sup></b>		

Potential energy efficiency rating:	A 103
Potential environmental impact rating:	A 102

Fuel prices for cost data on this page from database revision number 528 TEST (04 Oct 2023)  
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£349	£286	£63
Space heating	£95	£113	-£17
Water heating	£221	£141	£81
Lighting	£32	£32	£0
Generated (PV)	-£434	-£412	-£22
<b>Total cost of fuels</b>	<b>-£85</b>	<b>-£126</b>	<b>£41</b>
<b>Total cost of uses</b>	<b>-£86</b>	<b>-£126</b>	<b>£42</b>
Delivered energy	-26 kWh/m <sup>2</sup>	-32 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.2 tonnes	-0.2 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	-3 kg/m <sup>2</sup>	-4 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	-11 kWh/m <sup>2</sup>	-16 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>

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

## 1. Overall dwelling characteristics

Area Storey height Volume

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Ground floor		(m2)		(m)		(m3)
First floor		25.5500 (1b)	x	2.7600 (2b)	=	70.5180 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600	29.2100 (1c)	x	2.9500 (2c)	=	86.1695 (1c) -
Dwelling volume						(4) 156.6875 (5)

## 2. Ventilation rate

													m3 per hour	
Number of open chimneys													0 * 80 =	0.0000 (6a)
Number of open flues													0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire													0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler													0 * 20 =	0.0000 (6d)
Number of flues attached to other heater													0 * 35 =	0.0000 (6e)
Number of blocked chimneys													0 * 20 =	0.0000 (6f)
Number of intermittent extract fans													0 * 10 =	0.0000 (7a)
Number of passive vents													0 * 10 =	0.0000 (7b)
Number of flueless gas fires													0 * 40 =	0.0000 (7c)
													Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =													0.0000 / (5) =	0.0000 (8)
Pressure test														Yes
Pressure Test Method														Blower Door
Measured/design AP50														2.5000 (17)
Infiltration rate														0.1250 (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) =	0.1062 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000		(22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750		(22a)
Balanced mechanical ventilation with heat recovery	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248		(22b)
If mechanical ventilation														0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)														0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =														81.9000 (23c)
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153		(25)

## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)
5-6			1.0800	1.2357	1.3346		(27a)
9-11			1.6200	1.2357	2.0019		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215	110.0000	2810.5000 (28a)
External Wall 1 Render	96.8600	7.0000	89.8600	0.1000	8.9860	9.0000	808.7400 (29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1000	1.5790	9.0000	142.1100 (29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1500	5.2305	9.0000	313.8300 (30)
Total net area of external elements Aum(A, m2)			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	30.9055	(33)
Internal Wall 1			40.6600			9.0000	365.9400 (32c)
Internal Floor 1			22.2300			18.0000	400.1400 (32d)
Internal Ceiling 1			22.2300			9.0000	200.0700 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							5041.3300 (34)
List of Thermal Bridges							92.0623 (35)
K1 Element				Length	Psi-value	Total	
E5 Ground floor (normal)				21.6000	0.0640	1.3824	
E16 Corner (normal)				21.5400	0.0420	0.9047	
E17 Corner (inverted - internal area greater than external area)				2.7400	0.0790	0.2165	
E11 Eaves (insulation at rafter level)				14.6000	0.1500	2.1900	
E13 Gable (insulation at rafter level)				10.6200	0.2500	2.6550	
E20 Exposed floor (normal)				8.5500	0.3200	2.7360	
E21 Exposed floor (inverted)				6.3500	0.3200	2.0320	
R4 Ridge (vaulted ceiling)				7.3000	0.1200	0.8760	
E6 Intermediate floor within a dwelling				9.8500	0.0490	0.4827	
E2 Other lintels (including other steel lintels)				6.0500	0.0140	0.0847	
E3 Sill				4.2500	0.0460	0.1955	
E4 Jamb				16.3000	0.0050	0.0815	
R1 Head of roof window				2.7500	0.2400	0.6600	
R2 Sill of roof window				2.7500	0.2400	0.6600	
R3 Jamb of roof window				9.8000	0.2400	2.3520	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.5089 (36)
Point Thermal bridges							(36a) =
Total fabric heat loss							(33) + (36) + (36a) =

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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(38)m	11.6841	11.5468	11.4094	10.7227	10.5854	9.8986	9.8986	9.7613	10.1733	10.5854	10.8601	11.1348 (38)
Heat transfer coeff	60.0986	59.9612	59.8239	59.1371	58.9998	58.3131	58.3131	58.1757	58.5878	58.9998	59.2745	59.5492 (39)
Average = Sum(39)m / 12 =												59.1028

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0975	1.0950	1.0925	1.0799	1.0774	1.0649	1.0649	1.0624	1.0699	1.0774	1.0824	1.0875 (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												1.8303 (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	63.2632	62.3237	61.0006	58.5611	56.7344	54.7089	53.6148	54.9287	56.3592	58.5265	61.0163	63.0494 (42b)
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)
Average daily hot water use (litres/day)												88.9953 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	96.6376	94.4844	91.9477	88.2946	85.2543	82.0152	80.9211	83.4486	86.0927	89.4737	93.1770	96.4237 (44)
Energy content (annual)	153.0503	134.5446	141.3203	120.8709	114.7687	100.8472	97.8671	103.3267	106.1609	121.4149	132.7478	150.9762 (45)
Distribution loss (46)m = 0.15 x (45)m	22.9575	20.1817	21.1980	18.1306	17.2153	15.1271	14.6801	15.4990	15.9241	18.2122	19.9122	22.6464 (46)
Water storage loss:												210.0000 (47)
Store volume												1.8000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9720 (55)
Enter (49) or (54) in (55)												
Total storage loss	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (56)
If cylinder contains dedicated solar storage	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (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	206.4447	182.7718	193.3189	165.7893	155.3688	139.9125	138.2345	144.6247	152.4300	173.4136	184.4198	204.3706 (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												581.0105 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												581.0105
Solar input	-0.0000	-16.2867	-56.1815	-75.4547	-95.9972	-88.2280	-87.5207	-77.7779	-55.1695	-28.3943	-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	206.4447	166.4851	137.1374	90.3346	59.3716	51.6845	50.7139	66.8468	97.2605	145.0193	184.4198	204.3706 (64)
Total per year (kWh/year) = Sum(64)m =												1460.0887 (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	93.6048	83.3178	88.5879	76.1243	70.6407	64.7839	64.8348	67.3945	72.3138	81.9694	85.4762	92.9151 (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	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1702	18.8032	15.2918	11.5768	8.6538	7.3059	7.8943	10.2613	13.7727	17.4876	20.4107	21.7586 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	238.1595	240.6309	234.4032	221.1451	204.4091	188.6797	178.1715	175.7001	181.9278	195.1859	211.9219	227.6513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)	125.8128	123.9849	119.0698	105.7282	94.9471	89.9777	87.1435	90.5840	100.4358	110.1739	118.7170	124.8859 (72)
Total internal gains	469.5613	467.8377	453.1835	422.8689	392.4288	370.3820	357.6280	360.9642	380.5551	407.2662	435.4683	458.7145 (73)

## 6. Solar gains

[Jan]				Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
East				1.0400	19.6403	0.7600		0.7000	0.7700	7.5305 (76)		
South				2.3800	46.7521	0.7600		0.7000	0.7700	41.0225 (78)		
East				1.0800	26.0000	0.7600		0.7000	1.0000	13.4447 (82)		
West				1.6200	26.0000	0.7600		0.7000	1.0000	20.1671 (82)		
Solar gains	82.1648	151.7247	233.9463	326.0214	392.3658	399.9411	381.3668	331.3038	266.2826	175.2667	100.6765	68.7880 (83)
Total gains	551.7261	619.5624	687.1297	748.8902	784.7946	770.3232	738.9948	692.2680	646.8378	582.5330	536.1447	527.5025 (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	23.3012	23.3546	23.4082	23.6800	23.7352	24.0147	24.0147	24.0714	23.9021	23.7352	23.6252	23.5162
alpha	2.5534	2.5570	2.5605	2.5787	2.5823	2.6010	2.6010	2.6048	2.5935	2.5823	2.5750	2.5677
util living area	0.8890	0.8548	0.7970	0.7040	0.5836	0.4435	0.3324	0.3660	0.5400	0.7393	0.8528	0.8982 (86)
Living	19.3459	19.5761	19.9225	20.3144	20.6084	20.7869	20.8492	20.8393	20.7160	20.3304	19.7786	19.3004
Non living	18.0829	18.3682	18.7937	19.2701	19.6074	19.8039	19.8595	19.8546	19.7351	19.3036	18.6336	18.0326
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	20.1538	19.5761	19.9225	20.3144	20.6084	20.7869	20.8492	20.8393	20.7160	20.3304	19.7786	19.5381 (87)
Th 2	20.0029	20.0049	20.0070	20.0173	20.0193	20.0296	20.0296	20.0317	20.0255	20.0193	20.0152	20.0111 (88)
util rest of house	0.8761	0.8385	0.7747	0.6722	0.5398	0.3860	0.2640	0.2954	0.4813	0.7037	0.8337	0.8863 (89)
MIT 2	19.2374	18.3682	18.7937	19.2701	19.6074	19.8039	19.8595	19.8546	19.7351	19.3036	18.6336	18.3891 (90)
Living area fraction	fLA = Living area / (4) =											0.5334 (91)
MIT	19.7263	19.0125	19.3958	19.8272	20.1413	20.3282	20.3875	20.3798	20.2583	19.8513	19.2443	19.0020 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.7263	19.0125	19.3958	19.8272	20.1413	20.3282	20.3875	20.3798	20.2583	19.8513	19.2443	19.0020 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8722	0.8199	0.7594	0.6656	0.5455	0.4042	0.2897	0.3214	0.4959	0.6970	0.8165	0.8721 (94)
Useful gains	481.2116	507.9681	521.8135	498.4855	428.0798	311.3840	214.0778	222.4677	320.7848	406.0335	437.7593	460.0155 (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	927.0956	846.2023	771.4775	646.2025	498.0357	334.0309	220.8586	231.5303	360.8023	545.8260	719.8496	881.4481 (97)
Space heating kWh	331.7377	227.2934	185.7500	106.3562	52.0472	0.0000	0.0000	0.0000	0.0000	104.0056	203.1050	313.5458 (98a)
Space heating requirement - total per year (kWh/year)												1523.8409
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	331.7377	227.2934	185.7500	106.3562	52.0472	0.0000	0.0000	0.0000	0.0000	104.0056	203.1050	313.5458 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1523.8409
Space heating per m <sup>2</sup>												(98c) / (4) = 27.8276 (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)

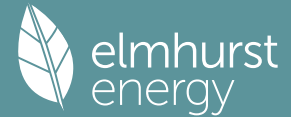
Efficiency of main space heating system 1 (in %) 401.0395 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	331.7377	227.2934	185.7500	106.3562	52.0472	0.0000	0.0000	0.0000	0.0000	104.0056	203.1050	313.5458 (98)
Space heating efficiency (main heating system 1)	401.0395	401.0395	401.0395	401.0395	401.0395	0.0000	0.0000	0.0000	0.0000	401.0395	401.0395	401.0395 (210)
Space heating fuel (main heating system)	82.7195	56.6761	46.3171	26.5201	12.9781	0.0000	0.0000	0.0000	0.0000	25.9340	50.6446	78.1833 (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)

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Water heating requirement	206.4447	166.4851	137.1374	90.3346	59.3716	51.6845	50.7139	66.8468	97.2605	145.0193	184.4198	204.3706 (64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600 (216)
Fuel for water heating, kWh/month	100.8720	81.3471	67.0074	44.1389	29.0099	25.2538	24.7796	32.6623	47.5230	70.8586	90.1103	99.8586 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	18.9386	17.1058	18.9386	18.3277	18.9386	18.3277	18.9386	18.9386	18.3277	18.9386	18.3277	18.9386 (231)
Lighting	18.5301	14.8656	13.3848	9.8063	7.5746	6.1886	6.9098	8.9817	11.6663	15.3068	17.2890	19.0451 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-51.6846	-85.9407	-141.3259	-166.4048	-170.6256	-151.1105	-149.2949	-146.4847	-132.3973	-104.7533	-60.6060	-42.6901 (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	-5.3273	-18.1663	-57.8318	-128.9602	-216.5936	-238.1517	-231.2470	-171.5618	-96.3957	-34.4642	-8.8352	-3.7669 (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												379.9728 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												204.6600
Water heating fuel used												713.4216 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.7000, SFP = 0.7480)												
mechanical ventilation fans (SFP = 0.7480)												142.9867 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												222.9867 (231)
Electricity for lighting (calculated in Appendix L)												149.5488 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2614.6202 (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												-1148.6903 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	379.9728	16.4900	62.6575 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	713.4216	16.4900	117.6432 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	142.9867	16.4900	23.5785 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	149.5488	16.4900	24.6606 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1403.3183	16.4900	-231.4072
PV Unit electricity exported	-1211.3019	5.5900	-67.7118
Total			-299.1190 (252)
Total energy cost			-57.3871 (255)

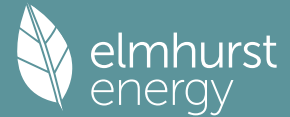
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.2071 (257)
SAP value		103.3569
SAP rating (Section 12)		103 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	379.9728	0.1554	59.0617 (261)

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Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	713.4216	0.1466	104.6083 (264)
Space and water heating			163.6700 (265)
Pumps, fans and electric keep-hot	222.9867	0.1387	30.9310 (267)
Energy for lighting	149.5488	0.1443	21.5845 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1403.3183	0.1338	-187.7366
PV Unit electricity exported	-1211.3019	0.1175	-142.3567
Total			-330.0933 (269)
Total CO2, kg/year			-113.9077 (272)
CO2 emissions per m2			-2.0800 (273)
EI value			101.5300
EI rating			102 (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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	25.5500 (1b)	x 2.7600 (2b)	= 70.5180 (1b) -
First floor	29.2100 (1c)	x 2.9500 (2c)	= 86.1695 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	156.6875 (5)

## 2. Ventilation rate

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

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		2.5000 (17)
Infiltration rate		0.1250 (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) =	0.1062 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.8000	5.5000	5.5000	5.0000	4.9000	4.3000	4.3000	4.1000	4.5000	5.1000	5.1000	5.7000 (22)
Wind factor	1.4500	1.3750	1.3750	1.2500	1.2250	1.0750	1.0750	1.0250	1.1250	1.2750	1.2750	1.4250 (22a)
Adj infilt rate	0.1541	0.1461	0.1461	0.1328	0.1302	0.1142	0.1142	0.1089	0.1195	0.1355	0.1355	0.1514 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2446	0.2366	0.2366	0.2233	0.2207	0.2047	0.2047	0.1994	0.2100	0.2260	0.2260	0.2419 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			3.4200	1.1450	3.9160		(27)
Door			3.7800	1.2000	4.5360		(26a)
5-6			1.0800	1.2357	1.3346		(27a)
9-11			1.6200	1.2357	2.0019		(27a)
Floor 1 P/a 0.85			25.5500	0.1300	3.3215	110.0000	2810.5000 (28a)

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External Wall 1 Render	96.8600	7.0000	89.8600	0.1000	8.9860	9.0000	808.7400 (29a)
External Wall 2 Clad	15.9900	0.2000	15.7900	0.1000	1.5790	9.0000	142.1100 (29a)
External Roof 1 Sloping	37.5700	2.7000	34.8700	0.1500	5.2305	9.0000	313.8300 (30)
Total net area of external elements Aum(A, m2)			175.9700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.9055		(33)
Internal Wall 1			40.6600			9.0000	365.9400 (32c)
Internal Floor 1			22.2300			18.0000	400.1400 (32d)
Internal Ceiling 1			22.2300			9.0000	200.0700 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 5041.3300 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 92.0623 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	21.6000	0.0640	1.3824
E16 Corner (normal)	21.5400	0.0420	0.9047
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0790	0.2165
E11 Eaves (insulation at rafter level)	14.6000	0.1500	2.1900
E13 Gable (insulation at rafter level)	10.6200	0.2500	2.6550
E20 Exposed floor (normal)	8.5500	0.3200	2.7360
E21 Exposed floor (inverted)	6.3500	0.3200	2.0320
R4 Ridge (vaulted ceiling)	7.3000	0.1200	0.8760
E6 Intermediate floor within a dwelling	9.8500	0.0490	0.4827
E2 Other lintels (including other steel lintels)	6.0500	0.0140	0.0847
E3 Sill	4.2500	0.0460	0.1955
E4 Jamb	16.3000	0.0050	0.0815
R1 Head of roof window	2.7500	0.2400	0.6600
R2 Sill of roof window	2.7500	0.2400	0.6600
R3 Jamb of roof window	9.8000	0.2400	2.3520

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.5089 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 48.4144 (37)

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

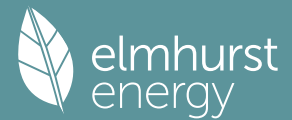
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	12.6456	12.2335	12.2335	11.5468	11.4094	10.5854	10.5854	10.3107	10.8601	11.6841	11.6841	12.5082 (38)
Average = Sum(39)m / 12 =	61.0600	60.6479	60.6479	59.9612	59.8239	58.9998	58.9998	58.7251	59.2745	60.0986	60.0986	60.9226 (39)
												59.9383

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1150	1.1075	1.1075	1.0950	1.0925	1.0774	1.0774	1.0724	1.0824	1.0975	1.0975	1.1125 (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													1.8303 (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	0.0000 (42a)
Hot water usage for baths	63.2632	62.3237	61.0006	58.5611	56.7344	54.7089	53.6148	54.9287	56.3592	58.5265	61.0163	63.0494 (42b)	
Hot water usage for other uses	33.3743	32.1607	30.9471	29.7335	28.5199	27.3063	27.3063	28.5199	29.7335	30.9471	32.1607	33.3743 (42c)	
Average daily hot water use (litres/day)													88.9953 (43)
Daily hot water use	96.6376	94.4844	91.9477	88.2946	85.2543	82.0152	80.9211	83.4486	86.0927	89.4737	93.1770	96.4237 (44)	
Energy content (annual)	153.0503	134.5446	141.3203	120.8709	114.7687	100.8472	97.8671	103.3267	106.1609	121.4149	132.7478	150.9762 (45)	
Distribution loss (46)m = 0.15 x (45)m	22.9575	20.1817	21.1980	18.1306	17.2153	15.1271	14.6801	15.4990	15.9241	18.2122	19.9122	22.6464 (46)	
Water storage loss:													210.0000 (47)
Store volume													1.8000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.9720 (55)
Enter (49) or (54) in (55)													
Total storage loss	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (56)	
If cylinder contains dedicated solar storage													
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	206.4447	182.7718	193.3189	165.7893	155.3688	139.9125	138.2345	144.6247	152.4300	173.4136	184.4198	204.3706 (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													703.6482 (H24)

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Heat delivered to space heating												0.0000 (H29)
Solar input												703.6482
Solar input	-7.5825	-25.1134	-68.0529	-88.6548	-103.4147	-102.8023	-93.5755	-90.8095	-70.0462	-42.5010	-11.0953	-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	198.8622	157.6584	125.2660	77.1345	51.9540	37.1102	44.6590	53.8152	82.3838	130.9125	173.3245	204.3706 (64)
											Total per year (kWh/year) = Sum(64)m =	1337.4510 (64)
Electric shower(s)												0.0000 (64a)
	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	93.6048	83.3178	88.5879	76.1243	70.6407	64.7839	64.8348	67.3945	72.3138	81.9694	85.4762	92.9151 (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
	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194	109.8194 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1702	18.8032	15.2918	11.5768	8.6538	7.3059	7.8943	10.2613	13.7727	17.4876	20.4107	21.7586 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	238.1595	240.6309	234.4032	221.1451	204.4091	188.6797	178.1715	175.7001	181.9278	195.1859	211.9219	227.6513 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123	47.8123 (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)	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130	-73.2130 (71)
Water heating gains (Table 5)	125.8128	123.9849	119.0698	105.7282	94.9471	89.9777	87.1435	90.5840	100.4358	110.1739	118.7170	124.8859 (72)
Total internal gains	469.5613	467.8377	453.1835	422.8689	392.4288	370.3820	357.6280	360.9642	380.5551	407.2662	435.4683	458.7145 (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						
East	1.0400	26.5119	0.7600	0.7000	0.7700	10.1653 (76)						
South	2.3800	58.6702	0.7600	0.7000	0.7700	51.4801 (78)						
East	1.0800	36.0000	0.7600	0.7000	1.0000	18.6157 (82)						
West	1.6200	36.0000	0.7600	0.7000	1.0000	27.9236 (82)						
Solar gains	108.1848	171.7876	263.1404	372.9819	423.8978	471.4569	411.4264	384.1195	316.1904	208.6719	127.7946	90.2446 (83)
Total gains	577.7461	639.6252	716.3238	795.8508	816.3266	841.8390	769.0544	745.0837	696.7455	615.9381	563.2629	548.9592 (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, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	22.9343	23.0901	23.0901	23.3546	23.4082	23.7352	23.7352	23.8462	23.6252	23.3012	23.3012	22.9860
alpha	2.5290	2.5393	2.5393	2.5570	2.5605	2.5823	2.5823	2.5897	2.5750	2.5534	2.5534	2.5324
util living area	0.8517	0.8183	0.7611	0.6786	0.5765	0.4317	0.3630	0.3719	0.5034	0.6788	0.8007	0.8572 (86)
Living	19.6744	19.8371	20.0828	20.3612	20.6058	20.7854	20.8338	20.8319	20.7417	20.4771	20.0723	19.6880
Non living	18.4826	18.6836	18.9780	19.3124	19.5924	19.7906	19.8364	19.8394	19.7492	19.4580	18.9837	18.5031
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	20.3219	19.8371	20.0828	20.3612	20.6058	20.7854	20.8338	20.8319	20.7417	20.4771	20.0723	19.8715 (87)
Th 2	19.9886	19.9947	19.9947	20.0049	20.0070	20.0193	20.0193	20.0234	20.0152	20.0029	20.0029	19.9906 (88)
util rest of house	0.8334	0.7970	0.7345	0.6453	0.5328	0.3773	0.2980	0.3059	0.4440	0.6349	0.7735	0.8388 (89)
MIT 2	19.3882	18.6836	18.9780	19.3124	19.5924	19.7906	19.8364	19.8394	19.7492	19.4580	18.9837	18.7712 (90)
Living area fraction												fLA = Living area / (4) =
MIT	19.8863	19.2989	19.5673	19.8719	20.1330	20.3213	20.3685	20.3688	20.2787	20.0016	19.5644	19.3581 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8863	19.2989	19.5673	19.8719	20.1330	20.3213	20.3685	20.3688	20.2787	20.0016	19.5644	19.3581 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8314	0.7805	0.7222	0.6405	0.5386	0.3945	0.3216	0.3297	0.4605	0.6348	0.7601	0.8257 (94)
Useful gains	480.3194	499.2053	517.2972	509.7448	439.6851	332.0744	247.3485	245.6862	320.8518	391.0049	428.1585	453.2661 (95)
Ext temp.	6.3000	6.6000	7.6000	9.1000	11.6000	14.3000	16.0000	16.0000	14.3000	11.8000	9.0000	6.7000 (96)
Heat loss rate W	829.5763	770.1624	725.7906	645.8937	510.4746	355.2536	257.7383	256.5587	354.3816	492.9062	634.9041	771.1654 (97)
Space heating kWh												

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259.8471	182.0832	155.1191	98.0272	52.6674	0.0000	0.0000	0.0000	0.0000	0.0000	75.8146	148.8568	236.5171 (98a)
Space heating requirement - total per year (kWh/year)												1208.9325
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	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh												
259.8471	182.0832	155.1191	98.0272	52.6674	0.0000	0.0000	0.0000	0.0000	0.0000	75.8146	148.8568	236.5171 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1208.9325
Space heating per m2												(98c) / (4) = 22.0769 (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 %)	401.2475 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	259.8471	182.0832	155.1191	98.0272	52.6674	0.0000	0.0000	0.0000	0.0000	75.8146	148.8568	236.5171	(98)
Space heating efficiency (main heating system 1)	401.2475	401.2475	401.2475	401.2475	401.2475	0.0000	0.0000	0.0000	0.0000	401.2475	401.2475	401.2475	(210)
Space heating fuel (main heating system)	64.7598	45.3793	38.6592	24.4306	13.1259	0.0000	0.0000	0.0000	0.0000	18.8947	37.0985	58.9454	(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	198.8622	157.6584	125.2660	77.1345	51.9540	37.1102	44.6590	53.8152	82.3838	130.9125	173.3245	204.3706	(64)
Efficiency of water heater (217)m	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	204.6600	(216)
Fuel for water heating, kWh/month	97.1671	77.0343	61.2069	37.6891	25.3855	18.1326	21.8211	26.2949	40.2540	63.9659	84.6890	99.8586	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	18.9386	17.1058	18.9386	18.3277	18.9386	18.3277	18.9386	18.9386	18.3277	18.9386	18.3277	18.9386	(231)
Lighting	18.5301	14.8656	13.3848	9.8063	7.5746	6.1886	6.9098	8.9817	11.6663	15.3068	17.2890	19.0451	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-68.1948	-97.2022	-154.2396	-175.9591	-172.9364	-149.2116	-149.5614	-149.9367	-143.1950	-120.2968	-76.3890	-56.4683	(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	-9.8100	-25.0000	-76.5933	-169.2896	-251.6674	-315.2058	-266.4488	-225.7135	-135.8273	-51.2130	-15.1627	-6.8865	(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												301.2935 (211)	
Space heating fuel - main system 2												0.0000 (213)	
Space heating fuel - secondary												0.0000 (215)	
Efficiency of water heater												204.6600	
Water heating fuel used												653.4990 (219)	
Space cooling fuel												0.0000 (221)	

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.7000, SFP = 0.7480)													
mechanical ventilation fans (SFP = 0.7480)												142.9867 (230a)	
pump for solar water heating												80.0000 (230g)	
Total electricity for the above, kWh/year												222.9867 (231)	
Electricity for lighting (calculated in Appendix L)												149.5488 (232)	

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3062.4084 (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												-1735.0804 (238)	

## 10a. Fuel costs - using BEDF prices (528)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	301.2935	21.5100	64.8082 (240)

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Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	653.4990	21.5100	140.5676 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	142.9867	21.5100	30.7564 (249)
Pump for solar water heating	80.0000	21.5100	17.2080 (249)
Energy for lighting	149.5488	21.5100	32.1679 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1513.5908	21.5100	-325.5734
PV Unit electricity exported	-1548.8176	5.5900	-86.5789
Total			-412.1523 (252)
Total energy cost			-126.6440 (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	301.2935	0.1551	46.7373 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	653.4990	0.1476	96.4872 (264)
Space and water heating			143.2245 (265)
Pumps, fans and electric keep-hot	222.9867	0.1387	30.9310 (267)
Energy for lighting	149.5488	0.1443	21.5845 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1513.5908	0.1349	-204.1253
PV Unit electricity exported	-1548.8176	0.1183	-183.2870
Total			-387.4123 (269)
Total CO2, kg/year			-191.6723 (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	301.2935	1.5743	474.3147 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	653.4990	1.5462	1010.4652 (278)
Space and water heating			1484.7799 (279)
Pumps, fans and electric keep-hot	222.9867	1.5128	337.3343 (281)
Energy for lighting	149.5488	1.5338	229.3830 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1513.5908	1.4985	-2268.0737
PV Unit electricity exported	-1548.8176	0.4340	-672.1820
Total			-2940.2558 (283)
Total Primary energy kWh/year			-888.7586 (286)