

# Full SAP Calculation Printout



Property Reference	KNIGHTLEY-7041-23 LH		Issued on Date	05/02/2024	
Assessment Reference	SEC1 - ASHP ROI	Prop Type Ref	DS		
Property	Bronsley , (Left Hand), Bodinnick Road, St Tudy, Bodmin, Cornwall, PL30 3NX				
SAP Rating	101 A	DER	-1.44	TER	9.76
Environmental	102 A	% DER < TER			114.75
CO <sub>2</sub> Emissions (t/year)	-0.35	DFEE	40.77	TFEE	48.66
Compliance Check	See BREL	% DFEE < TFEE			16.21
% DPER < TPER	97.87	DPER	1.10	TPER	51.74
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	103.9300 (1b)	2.9000 (2b)	301.3970 (1b) - (3b)
First floor	61.2500 (1c)	2.7000 (2c)	165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	466.7720 (5)

## 2. Ventilation rate

	m3 per hour											
Number of open chimneys	0 * 80 =											0.0000 (6a)
Number of open flues	0 * 20 =											0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)
Number of blocked chimneys	0 * 20 =											0.0000 (6f)
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)
Number of passive vents	0 * 10 =											0.0000 (7b)
Number of flueless gas fires	0 * 40 =											0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =											0.0000 (8)
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50												0.9500 (17)
Infiltration rate												0.0475 (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) =											0.0404 (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	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (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 = 0.90)			30.1000	0.8687	26.1486		(27)
Door			2.1000	0.9000	1.8900		(26a)
16-18			6.0000	1.2357	7.4144		(27a)
19			2.5000	1.2357	3.0894		(27a)
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000 (28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500 (29a)
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000 (29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400 (29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400 (30)
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200 (30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		90.2786		(33)
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000 (32)

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Internal Wall 1 GF	168.5800	9.0000	1517.2200 (32c)
Internal Wall 2 FF	135.0400	9.0000	1215.3600 (32c)
Internal Floor 1	61.2500	18.0000	1102.5000 (32d)
Internal Ceiling 1	61.2500	9.0000	551.2500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19028.6500 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 115.1995 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E6 Corner (normal)	21.0700	0.0300	0.6321
E5 Ground floor (normal)	35.9500	0.0210	0.7550
E11 Eaves (insulation at rafter level)	23.0400	0.0390	0.8986
R4 Ridge (vaulted ceiling)	19.9000	0.1200	2.3880
E13 Gable (insulation at rafter level)	24.4900	0.0240	0.5878
E6 Intermediate floor within a dwelling	17.5100	0.0800	1.4008
R7 Flat ceiling (inverted)	18.3500	0.1200	2.2020
E14 Flat roof	11.1800	0.0460	0.5143
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0150	-0.0795
P1 Party wall - Ground floor	6.9000	0.1490	1.0281
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0810	0.7047
E18 Party wall between dwellings	8.7900	0.0395	0.3472
E2 Other lintels (including other steel lintels)	26.6400	0.0840	2.2378
E3 Sill	25.6400	0.0430	1.1025
E4 Jamb	37.9200	0.0340	1.2893
R1 Head of roof window	2.5000	0.2400	0.6000
R2 Sill of roof window	2.5000	0.2400	0.6000
R3 Jamb of roof window	2.0000	0.2400	0.4800
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.0085 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 112.2871 (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	22.5627	22.4072	22.2518	21.4744	21.3189	20.5415	20.5415	20.3860	20.8525	21.3189	21.6298	21.9408 (38)
Average = Sum(39)m / 12 =	134.8498	134.6944	134.5389	133.7615	133.6060	132.8286	132.8286	132.6731	133.1396	133.6060	133.9170	134.2279 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8164	0.8154	0.8145	0.8098	0.8089	0.8041	0.8041	0.8032	0.8060	0.8089	0.8107	0.8126 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 2.9561 (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 85.1167 83.8526 82.0725 78.7903 76.3326 73.6074 72.1354 73.9030 75.8277 78.7437 82.0936 84.8289 (42b)

Hot water usage for other uses 44.9031 43.2702 41.6374 40.0046 38.3717 36.7389 36.7389 38.3717 40.0046 41.6374 43.2702 44.9031 (42c)

Average daily hot water use (litres/day) 119.7376 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	130.0198	127.1228	123.7099	118.7948	114.7043	110.3462	108.8742	112.2747	115.8323	120.3811	125.3638	129.7320 (44)
Energy content (annual)	205.9195	181.0212	190.1375	162.6242	154.4140	135.6836	131.6740	139.0196	142.8328	163.3561	178.6037	203.1290 (45)
Distribution loss (46)m = 0.15 x (45)m	30.8879	27.1532	28.5206	24.3936	23.1621	20.3525	19.7511	20.8529	21.4249	24.5034	26.7906	30.4693 (46)

Water storage loss:  
 Store volume 250.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.6000 (48)  
 Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.8640 (55)

Total storage loss 26.7840 24.1920 26.7840 25.9200 26.7840 25.9200 26.7840 26.7840 25.9200 26.7840 25.9200 26.7840 (56)

If cylinder contains dedicated solar storage 26.7840 24.1920 26.7840 25.9200 26.7840 25.9200 26.7840 26.7840 25.9200 26.7840 25.9200 26.7840 (57)

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

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

Total heat required for water heating calculated for each month 255.9659 226.2244 240.1839 211.0562 204.4604 184.1156 181.7204 189.0660 191.2648 213.4025 227.0357 253.1754 (62)

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

FV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)

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

FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)

Output from w/h 255.9659 226.2244 240.1839 211.0562 204.4604 184.1156 181.7204 189.0660 191.2648 213.4025 227.0357 253.1754 (64)

Total per year (kWh/year) = Sum(64)m = 2577.6710 (64)  
 2578 (64)

12Total per year (kWh/year) 2578 (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 108.5054 96.3521 103.2578 92.8181 91.3798 83.8604 83.8187 86.2611 86.2375 94.3530 98.1313 107.5775 (65)

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	169.8028	187.9960	169.8028	175.4629	169.8028	175.4629	169.8028	169.8028	175.4629	169.8028	175.4629	169.8028 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	336.6009	340.0937	331.2918	312.5536	288.9000	266.6689	251.8172	248.3243	257.1262	275.8645	299.5181	321.7492 (68)
Pumps, fans	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)

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Total internal gains	145.8405	143.3811	138.7874	128.9141	122.8223	116.4728	112.6596	115.9424	119.7743	126.8186	136.2935	144.5934 (72)
	719.5852	738.8118	707.2231	684.2716	648.8661	625.9456	601.6206	601.4105	619.7044	639.8268	678.6155	703.4864 (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						
North	1.9200	10.6334	0.6800	0.7000	0.7700	6.7346 (74)						
East	9.8000	19.6403	0.6800	0.7000	0.7700	63.4912 (76)						
West	18.3800	19.6403	0.6800	0.7000	0.7700	119.0784 (80)						
North	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)						
Horizontal	2.5000	26.0000	0.7600	0.7000	1.0000	31.1220 (82)						
Solar gains	295.1190	589.7843	1000.7372	1503.4044	1879.9962	1940.7841	1841.0419	1556.5584	1178.3837	707.7096	370.2543	241.2165 (83)
Total gains	1014.7043	1328.5961	1707.9603	2187.6760	2528.8623	2566.7297	2442.6625	2157.9690	1798.0881	1347.5364	1048.8698	944.7029 (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	39.1972	39.2424	39.2878	39.5161	39.5621	39.7937	39.7937	39.8403	39.7007	39.5621	39.4702	39.3788
alpha	3.6131	3.6162	3.6192	3.6344	3.6375	3.6529	3.6529	3.6560	3.6467	3.6375	3.6313	3.6253
util living area	0.9684	0.9265	0.8323	0.6543	0.4718	0.3273	0.2383	0.2808	0.4883	0.7962	0.9415	0.9748 (86)
Living	19.7103	20.0248	20.4123	20.7372	20.8682	20.9060	20.9133	20.9115	20.8768	20.6141	20.0843	19.6474
Non living	18.7035	19.0977	19.5718	19.9521	20.0935	20.1342	20.1402	20.1399	20.1079	19.8247	19.1805	18.6264
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	20.3402	20.0248	20.4123	20.7372	20.8682	20.9060	20.9133	20.9115	20.8768	20.6141	20.0843	19.8366 (87)
Th 2	20.2392	20.2400	20.2408	20.2449	20.2457	20.2497	20.2497	20.2506	20.2481	20.2457	20.2440	20.2424 (88)
util rest of house	0.9638	0.9169	0.8134	0.6248	0.4374	0.2901	0.1980	0.2358	0.4408	0.7665	0.9322	0.9710 (89)
MIT 2	19.6269	19.0977	19.5718	19.9521	20.0935	20.1342	20.1402	20.1399	20.1079	19.8247	19.1805	18.9176 (90)
Living area fraction										FLA = Living area / (4) =		0.2815 (91)
MIT	19.8277	19.3586	19.8084	20.1731	20.3115	20.3514	20.3578	20.3571	20.3243	20.0468	19.4349	19.1763 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8277	19.3586	19.8084	20.1731	20.3115	20.3514	20.3578	20.3571	20.3243	20.0468	19.4349	19.1763 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9610	0.9038	0.8016	0.6219	0.4405	0.2951	0.2039	0.2422	0.4457	0.7580	0.9201	0.9646 (94)
Useful gains	975.1345	1200.8156	1369.1112	1360.4487	1113.8501	757.5139	497.9372	522.7321	801.4564	1021.4200	965.0598	911.2739 (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	2093.9065	1947.4985	1790.4916	1507.9046	1150.5488	763.9495	499.1396	524.9984	828.7039	1262.1557	1651.8483	2010.2344 (97)
Space heating kWh	832.3664	501.7709	313.5071	106.1682	27.3038	0.0000	0.0000	0.0000	0.0000	179.1074	494.4877	817.6266 (98a)
Space heating requirement - total per year (kWh/year)												3272.3382
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	832.3664	501.7709	313.5071	106.1682	27.3038	0.0000	0.0000	0.0000	0.0000	179.1074	494.4877	817.6266 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3272.3382
Space heating per m2										(98c) / (4) =		19.8107 (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 %)	363.3460 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	65.0000 (208)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	832.3664	501.7709	313.5071	106.1682	27.3038	0.0000	0.0000	0.0000	0.0000	179.1074	494.4877	817.6266 (98)
Space heating efficiency (main heating system 1)	363.3460	363.3460	363.3460	363.3460	363.3460	0.0000	0.0000	0.0000	0.0000	363.3460	363.3460	363.3460 (210)
Space heating fuel (main heating system)	229.0837	138.0973	86.2833	29.2196	7.5146	0.0000	0.0000	0.0000	0.0000	49.2939	136.0928	225.0270 (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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (64)
Efficiency of water heater (217)m	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274 (217)
Fuel for water heating, kWh/month	129.3232	114.2967	121.3495	106.6331	103.3007	93.0218	91.8116	95.5229	96.6338	107.8186	114.7066	127.9133 (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	40.4334	36.5204	40.4334	39.1290	40.4334	39.1290	40.4334	40.4334	39.1290	40.4334	39.1290	40.4334 (231)
Lighting	32.8298	26.3373	23.7138	17.3737	13.4200	10.9642	12.2422	15.9128	20.6692	27.1191	30.6309	33.7422 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												

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(233a)m	-97.7012	-134.8752	-187.4594	-199.9111	-208.5573	-192.1259	-189.8560	-181.5816	-164.5027	-146.9801	-105.3357	-84.4367	(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	-52.5583	-115.8647	-239.5794	-372.4050	-498.4911	-503.0153	-496.0986	-417.7403	-304.8866	-173.5575	-72.8937	-41.3049	(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												900.6121	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												197.9274	
Water heating fuel used												1302.3317	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)													
mechanical ventilation fans (SFP = 0.8360)												476.0701	(230a)
Total electricity for the above, kWh/year												476.0701	(231)
Electricity for lighting (calculated in Appendix L)												264.9553	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5181.7182	(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												-2237.7489	(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	900.6121	0.1574	141.7413 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1302.3317	0.1409	183.4933 (264)
Space and water heating			325.2346 (265)
Pumps, fans and electric keep-hot	476.0701	0.1387	66.0368 (267)
Energy for lighting	264.9553	0.1443	38.2412 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1893.3229	0.1355	-256.4972
PV Unit electricity exported	-3288.3953	0.1251	-411.2805
Total			-667.7777 (269)
Total CO2, kg/year			-238.2651 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-1.4400 (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	900.6121	1.5826	1425.2673 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1302.3317	1.5210	1980.8231 (278)
Space and water heating			3406.0904 (279)
Pumps, fans and electric keep-hot	476.0701	1.5128	720.1988 (281)
Energy for lighting	264.9553	1.5338	406.3973 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1893.3229	1.5007	-2841.3957
PV Unit electricity exported	-3288.3953	0.4591	-1509.6279
Total			-4351.0236 (283)
Total Primary energy kWh/year			181.6629 (286)
Dwelling Primary energy Rate (DPER)			1.1000 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 466.7720 (5)

### 2. Ventilation rate

m3 per hour

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Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.0857 (8)

Pressure test Yes

Pressure Test Method Blower Door

Measured/design AP50 5.0000 (17)

Infiltration rate 0.3357 (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) = 0.2853 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000
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
Adj infilt rate												
Effective ac	0.3638	0.3567	0.3495	0.3139	0.3067	0.2711	0.2711	0.2639	0.2853	0.3067	0.3210	0.3353
	0.5662	0.5636	0.5611	0.5493	0.5470	0.5367	0.5367	0.5348	0.5407	0.5470	0.5515	0.5562

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type (Uw = 1.20)			30.1000	1.1450	34.4656		(27)
19			2.5000	1.5918	3.9794		(27a)
16-18			6.0000	2.0221	12.1324		(27a)
Floor 1 P/a 0.35			103.9300	0.1300	13.5109		(28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1800	15.8670		(29a)
External Wall 3 "attic"	15.9000		15.9000	0.1800	2.8620		(29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1800	13.4388		(29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1100	5.8366		(30)
External Roof 3 "attic"	32.7800		32.7800	0.1100	3.6058		(30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1100	2.1593		(30)
Total net area of external elements Aum(A, m2)			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)					109.9578		(32)
Party Wall 1			32.6200	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 115.1995 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	21.0700	0.0900	1.8963
E5 Ground floor (normal)	35.9500	0.1600	5.7520
E11 Eaves (insulation at rafter level)	23.0400	0.0400	0.9216
R4 Ridge (vaulted ceiling)	19.9000	0.0800	1.5920
E13 Gable (insulation at rafter level)	24.4900	0.0800	1.9592
E6 Intermediate floor within a dwelling	17.5100	0.0000	0.0000
R7 Flat ceiling (inverted)	18.3500	0.0400	0.7340
E14 Flat roof	11.1800	0.0800	0.8944
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0900	-0.4770
P1 Party wall - Ground floor	6.9000	0.0800	0.5520
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0800	0.6960
E18 Party wall between dwellings	8.7900	0.0600	0.5274
E2 Other lintels (including other steel lintels)	26.6400	0.0500	1.3320
E3 Sill	25.6400	0.0500	1.2820
E4 Jamb	37.9200	0.0500	1.8960
R1 Head of roof window	2.5000	0.0800	0.2000
R2 Sill of roof window	2.5000	0.0600	0.1500
R3 Jamb of roof window	2.0000	0.0800	0.1600
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.5079 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 131.4657 (37)

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

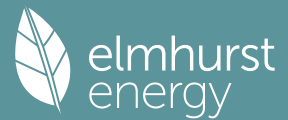
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	87.2112	86.8154	86.4274	84.6049	84.2640	82.6767	82.6767	82.3827	83.2881	84.2640	84.9537	85.6749
Heat transfer coeff	218.6769	218.2811	217.8931	216.0706	215.7297	214.1424	214.1424	213.8485	214.7538	215.7297	216.4194	217.1406
Average = Sum(39)m / 12 =												216.0690

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1.3239	1.3215	1.3191	1.3081	1.3060	1.2964	1.2964	1.2946	1.3001	1.3060	1.3102	1.3146
HLP (average)												1.3081
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9561 (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												
85.1167	83.8526	82.0725	78.7903	76.3326	73.6074	72.1354	73.9030	75.8277	78.7437	82.0936	84.8289	84.8289 (42b)
Hot water usage for other uses												
44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031	44.9031 (42c)
Average daily hot water use (litres/day)												119.7376 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	130.0198	127.1228	123.7099	118.7948	114.7043	110.3462	108.8742	112.2747	115.8323	120.3811	125.3638	129.7320 (44)
Energy conte	205.9195	181.0212	190.1375	162.6242	154.4140	135.6836	131.6740	139.0196	142.8328	163.3561	178.6037	203.1290 (45)
Energy content (annual)												Total = Sum(45)m = 1988.4150

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Distribution loss (46)m = 0.15 x (45)m	30.8879	27.1532	28.5206	24.3936	23.1621	20.3525	19.7511	20.8529	21.4249	24.5034	26.7906	30.4693 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0208 (55)
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)
If cylinder contains dedicated solar storage	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	260.8263	230.6144	245.0443	215.7598	209.3208	188.8192	186.5807	193.9264	195.9684	218.2629	231.7393	258.0358 (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	260.8263	230.6144	245.0443	215.7598	209.3208	188.8192	186.5807	193.9264	195.9684	218.2629	231.7393	258.0358 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2634.8982 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Heat gains from water heating, kWh/month	112.3937	99.8641	107.1461	96.5810	95.2681	87.6233	87.7070	90.1494	90.0004	98.2413	101.8942	111.4658 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	169.7765	187.9668	169.7765	175.4357	169.7765	175.4357	169.7765	169.7765	175.4357	169.7765	175.4357	169.7765 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.6009	340.0937	331.2918	312.5536	288.9000	266.6689	251.8172	248.3243	257.1262	275.8645	299.5181	321.7492 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803 (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)	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)
Water heating gains (Table 5)	151.0668	148.6073	144.0136	134.1403	128.0485	121.6990	117.8858	121.1686	125.0005	132.0448	141.5197	149.8197 (72)
Total internal gains	727.7851	747.0089	715.4230	692.4706	657.0660	631.1446	606.8205	606.6104	624.9035	648.0267	686.8145	711.6863 (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						
North	1.9200	10.6334	0.6300	0.7000	0.7700	6.2394 (74)						
East	9.8000	19.6403	0.6300	0.7000	0.7700	58.8227 (76)						
West	18.3800	19.6403	0.6300	0.7000	0.7700	110.3226 (80)						
Horizontal	2.5000	26.0000	0.6300	0.7000	1.0000	25.7985 (82)						
North	6.0000	26.0000	0.6300	0.7000	1.0000	61.9164 (82)						
Solar gains	263.0997	524.9852	889.0512	1333.3249	1665.5564	1718.6994	1630.6571	1379.7923	1046.0943	629.4767	329.9320	215.1451 (83)
Total gains	990.8848	1271.9941	1604.4741	2025.7956	2322.6224	2349.8440	2237.4776	1986.4028	1670.9978	1277.5035	1016.7465	926.8314 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	24.1714	24.2153	24.2584	24.4630	24.5017	24.6833	24.6833	24.7172	24.6130	24.5017	24.4236	24.3425
alpha	2.6114	2.6144	2.6172	2.6309	2.6334	2.6456	2.6456	2.6478	2.6409	2.6334	2.6282	2.6228
util living area	0.9756	0.9541	0.9086	0.8094	0.6699	0.5153	0.3953	0.4531	0.6805	0.8878	0.9610	0.9793 (86)
MIT	18.1216	18.5319	19.1733	19.9502	20.5146	20.8276	20.9375	20.9095	20.6278	19.8043	18.8137	18.0543 (87)
Th 2	19.8222	19.8241	19.8259	19.8345	19.8361	19.8436	19.8436	19.8450	19.8407	19.8361	19.8328	19.8294 (88)
util rest of house	0.9712	0.9460	0.8927	0.7777	0.6174	0.4399	0.3006	0.3535	0.6084	0.8610	0.9528	0.9756 (89)
MIT 2	16.4770	16.9963	17.7992	18.7466	19.3920	19.7200	19.8131	19.7972	19.5411	18.6018	17.3648	16.3954 (90)
Living area fraction										FLA = Living area / (4) =		0.2815 (91)
MIT	16.9399	17.4285	18.1859	19.0854	19.7080	20.0317	20.1296	20.1103	19.8469	18.9403	17.7726	16.8623 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9399	17.4285	18.1859	19.0854	19.7080	20.0317	20.1296	20.1103	19.8469	18.9403	17.7726	16.8623 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9549	0.9228	0.8640	0.7539	0.6111	0.4528	0.3249	0.3775	0.6088	0.8347	0.9317	0.9610 (94)
Useful gains	946.1551	1173.8533	1386.2220	1527.1993	1419.4455	1064.1231	726.9355	749.9527	1017.2777	1066.3167	947.3447	890.6613 (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	2764.0460	2734.7375	2546.2869	2200.7569	1727.5557	1163.1599	755.8334	793.4358	1234.1788	1799.2419	2309.7621	2749.5006 (97)
Space heating kWh	1352.5108	1048.9142	863.0883	484.9615	229.2340	0.0000	0.0000	0.0000	0.0000	545.2964	980.9405	1382.9764 (98a)
Space heating requirement - total per year (kWh/year)												6887.9220
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

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Space heating kWh	1352.5108	1048.9142	863.0883	484.9615	229.2340	0.0000	0.0000	0.0000	0.0000	545.2964	980.9405	1382.9764	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6887.9220	
Space heating per m2												(98c) / (4) =	41.6995 (99)

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

Fraction of space heat from secondary/supplementary system (Table 1)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1352.5108	1048.9142	863.0883	484.9615	229.2340	0.0000	0.0000	0.0000	0.0000	545.2964	980.9405	1382.9764	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	1465.3421	1136.4184	935.0902	525.4187	248.3575	0.0000	0.0000	0.0000	0.0000	590.7870	1062.7741	1498.3493	(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	260.8263	230.6144	245.0443	215.7598	209.3208	188.8192	186.5807	193.9264	195.9684	218.2629	231.7393	258.0358	(64)
Efficiency of water heater (217)m	87.2099	87.0309	86.6392	85.8198	84.2640	79.8000	79.8000	79.8000	79.8000	86.0266	86.9265	87.2527	(217)
Fuel for water heating, kWh/month	299.0789	264.9799	282.8329	251.4104	248.4106	236.6155	233.8105	243.0155	245.5744	253.7155	266.5921	295.7340	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	35.2762	28.2999	25.4809	18.6684	14.4200	11.7813	13.1544	17.0986	22.2094	29.1399	32.9135	36.2566	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-83.4745	-111.3150	-151.3971	-160.6875	-165.5094	-151.6077	-149.4859	-144.6354	-135.3556	-122.2968	-89.3607	-72.9167	(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	-68.6995	-141.3435	-275.3800	-405.9419	-529.7142	-529.8958	-523.8649	-446.9114	-331.9745	-199.7487	-90.8909	-54.5929	(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												7462.5374	(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												3121.7702	(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)												284.6992	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5137.0006	(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												5818.0061	(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	7462.5374	0.2100	1567.1328	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3121.7702	0.2100	655.5717	(264)
Space and water heating			2222.7046	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	284.6992	0.1443	41.0909	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1538.0424	0.1358	-208.9157	
PV Unit electricity exported	-3598.9583	0.1264	-455.0793	
Total			-663.9950	(269)
Total CO2, kg/year			1611.7297	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7600	(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	7462.5374	1.1300	8432.6672	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3121.7702	1.1300	3527.6004	(278)
Space and water heating			11960.2676	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)

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Energy for lighting	284.6992	1.5338	436.6811 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1538.0424	1.5021	-2310.2647
PV Unit electricity exported	-3598.9583	0.4642	-1670.5398
Total			-3980.8045 (283)
Total Primary energy kWh/year			8546.2450 (286)
Target Primary Energy Rate (TPER)			51.7400 (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	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 466.7720 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour												
Number of open chimneys	0 * 80 =											0.0000 (6a)	
Number of open flues	0 * 20 =											0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)	
Number of blocked chimneys	0 * 20 =											0.0000 (6f)	
Number of intermittent extract fans	4 * 10 =											40.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												40.0000 / (5) =	0.0857 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												0.9500	(17)
Infiltration rate												0.1332	(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) =	0.1132 (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)
	0.1444	0.1415	0.1387	0.1245	0.1217	0.1076	0.1076	0.1047	0.1132	0.1217	0.1274	0.1330	(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	0.5104	0.5100	0.5096	0.5078	0.5074	0.5058	0.5058	0.5055	0.5064	0.5074	0.5081	0.5088	(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 = 0.90)			30.1000	0.8687	26.1486		(27)
Door			2.1000	0.9000	1.8900		(26a)
16-18			6.0000	1.2357	7.4144		(27a)
19			2.5000	1.2357	3.0894		(27a)
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000 (28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500 (29a)
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000 (29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400 (29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400 (30)
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200 (30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		90.2786		(33)
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000 (32)
Internal Wall 1 GF			168.5800			9.0000	1517.2200 (32c)
Internal Wall 2 FF			135.0400			9.0000	1215.3600 (32c)
Internal Floor 1			61.2500			18.0000	1102.5000 (32d)
Internal Ceiling 1			61.2500			9.0000	551.2500 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				19028.6500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							115.1995 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	21.0700	0.0300	0.6321
E5 Ground floor (normal)	35.9500	0.0210	0.7550
E11 Eaves (insulation at rafter level)	23.0400	0.0390	0.8986
R4 Ridge (vaulted ceiling)	19.9000	0.1200	2.3880
E13 Gable (insulation at rafter level)	24.4900	0.0240	0.5878
E6 Intermediate floor within a dwelling	17.5100	0.0800	1.4008
R7 Flat ceiling (inverted)	18.3500	0.1200	2.2020
E14 Flat roof	11.1800	0.0460	0.5143
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0150	-0.0795



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P1 Party wall - Ground floor	6.9000	0.1490	1.0281
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0810	0.7047
E18 Party wall between dwellings	8.7900	0.0395	0.3472
E2 Other lintels (including other steel lintels)	26.6400	0.0840	2.2378
E3 Sill	25.6400	0.0430	1.1025
E4 Jamb	37.9200	0.0340	1.2893
R1 Head of roof window	2.5000	0.2400	0.6000
R2 Sill of roof window	2.5000	0.2400	0.6000
R3 Jamb of roof window	2.0000	0.2400	0.4800
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			22.0085 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			(33) + (36) + (36a) = 112.2871 (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	78.6222	78.5599	78.4988	78.2119	78.1582	77.9083	77.9083	77.8620	78.0046	78.1582	78.2668	78.3803 (38)
Average = Sum(39)m / 12 =	190.9093	190.8470	190.7859	190.4990	190.4453	190.1954	190.1954	190.1492	190.2917	190.4453	190.5539	190.6674 (39)
												190.4988

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1558	1.1554	1.1550	1.1533	1.1530	1.1514	1.1514	1.1512	1.1520	1.1530	1.1536	1.1543 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9561 (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	31.8525	31.3794	30.7133	29.4850	28.5653	27.5454	26.9946	27.6561	28.3763	29.4676	30.7212	31.7448 (42b)
Hot water usage for other uses	44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031 (42c)
Average daily hot water use (litres/day)												70.3532 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	76.7555	74.6497	72.3507	69.4895	66.9370	64.2843	63.7335	66.0278	68.3809	71.1050	73.9914	76.6479 (44)
Energy content (annual)	121.5620	106.3001	111.2003	95.1277	90.1100	79.0451	77.0801	81.7562	84.3205	96.4888	105.4143	120.0120 (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												
WWHRS	103.3277	90.3551	94.5202	80.8586	76.5935	67.1883	65.5181	69.4928	71.6724	82.0155	89.6022	102.0102 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	103.3277	90.3551	94.5202	80.8586	76.5935	67.1883	65.5181	69.4928	71.6724	82.0155	89.6022	102.0102 (64)
12Total per year (kWh/year)												993.1546 (64)
Electric shower(s)	59.0882	52.6480	57.4897	54.8617	55.8911	53.3147	55.0919	55.8911	54.8617	57.4897	56.4086	59.0882 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												672.1245 (64a)
Heat gains from water heating, kWh/month	40.6040	35.7508	38.0025	33.9301	33.1212	30.1258	30.1525	31.3460	31.6335	34.8763	36.5027	40.2746 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	169.8028	187.9960	169.8028	175.4629	169.8028	175.4629	169.8028	169.8028	175.4629	169.8028	175.4629	169.8028 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.6009	340.0937	331.2918	312.5536	288.9000	266.6689	251.8172	248.3243	257.1262	275.8645	299.5181	321.7492 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803 (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)	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)
Water heating gains (Table 5)	54.5752	53.2006	51.0786	47.1251	44.5177	41.8413	40.5275	42.1317	43.9354	46.8767	50.6982	54.1325 (72)
Total internal gains	628.3199	648.6313	619.5142	602.4826	570.5615	551.3142	529.4886	527.5998	543.8656	559.8850	593.0202	613.0255 (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						
North	1.9200	10.6334	0.6800	0.7000	0.7700	6.7346 (74)						
East	9.8000	19.6403	0.6800	0.7000	0.7700	63.4912 (76)						
West	18.3800	19.6403	0.6800	0.7000	0.7700	119.0784 (80)						
North	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)						
Horizontal	2.5000	26.0000	0.7600	0.7000	1.0000	31.1220 (82)						
Solar gains	295.1190	589.7843	1000.7372	1503.4044	1879.9962	1940.7841	1841.0419	1556.5584	1178.3837	707.7096	370.2543	241.2165 (83)

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Total gains 923.4390 1238.4156 1620.2514 2105.8870 2450.5577 2492.0983 2370.5305 2084.1583 1722.2493 1267.5946 963.2744 854.2420 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	27.6872	27.6962	27.7051	27.7468	27.7546	27.7911	27.7911	27.7978	27.7770	27.7546	27.7388	27.7223
alpha	2.8458	2.8464	2.8470	2.8498	2.8503	2.8527	2.8527	2.8532	2.8518	2.8503	2.8493	2.8482
util living area	0.9789	0.9537	0.8964	0.7727	0.6114	0.4539	0.3411	0.3985	0.6335	0.8771	0.9636	0.9829 (86)
MIT	18.4210	18.8640	19.5161	20.2341	20.6918	20.9027	20.9680	20.9500	20.7491	20.0181	19.0562	18.3301 (87)
Th 2	19.9556	19.9559	19.9562	19.9576	19.9578	19.9590	19.9590	19.9593	19.9586	19.9578	19.9573	19.9567 (88)
util rest of house	0.9753	0.9460	0.8801	0.7403	0.5624	0.3895	0.2648	0.3158	0.5661	0.8504	0.9563	0.9799 (89)
MIT 2	17.5979	18.0342	18.6673	19.3391	19.7382	19.9041	19.9464	19.9381	19.8004	19.1620	18.2300	17.5087 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.8296	18.2678	18.9062	19.5910	20.0066	20.1852	20.2340	20.2229	20.0674	19.4029	18.4625	17.7399 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.8296	18.2678	18.9062	19.5910	20.0066	20.1852	20.2340	20.2229	20.0674	19.4029	18.4625	17.7399 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9649	0.9299	0.8603	0.7277	0.5649	0.4039	0.2854	0.3373	0.5736	0.8332	0.9422	0.9709 (94)
Useful gains	891.0473	1151.5782	1393.8216	1532.5421	1384.2254	1006.6751	676.4840	703.0691	987.9300	1056.2021	907.6094	829.3947 (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	2582.9190	2551.1976	2366.9264	2036.6181	1581.9461	1062.2747	691.1627	726.9262	1135.5421	1676.4804	2165.1762	2581.6173 (97)
Space heating kWh	1258.7526	940.5443	723.9900	362.9347	147.1042	0.0000	0.0000	0.0000	0.0000	461.4870	905.4481	1303.6536 (98a)
Space heating requirement - total per year (kWh/year)	6103.9145											
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	1258.7526	940.5443	723.9900	362.9347	147.1042	0.0000	0.0000	0.0000	0.0000	461.4870	905.4481	1303.6536 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	6103.9145											
Space heating per m2	(98c) / (4) = 36.9531 (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	1787.8372	1407.4463	1445.1337	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8691	0.9099	0.8774	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1553.7564	1280.6482	1268.0285	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2700.5527	2569.2451	2259.9238	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	825.6933	958.7160	737.9701	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	206.4233	239.6790	184.4925	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	630.5949 (107)											
Energy for space heating	36.9531 (99)											
Energy for space cooling	3.8176 (108)											
Total	40.7707 (109)											
Fabric Energy Efficiency (DFEE)	40.8 (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 (m2)	Storey height (m)	Volume (m3)
Ground floor	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		466.7720 (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)

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Number of intermittent extract fans		4 * 10 =	40.0000 (7a)
Number of passive vents		0 * 10 =	0.0000 (7b)
Number of flueless gas fires		0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =			40.0000 / (5) = 0.0857 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3357 (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) =	0.2853 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3638	0.3567	0.3495	0.3139	0.3067	0.2711	0.2711	0.2639	0.2853	0.3067	0.3210	0.3353 (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	0.5662	0.5636	0.5611	0.5493	0.5470	0.5367	0.5367	0.5348	0.5407	0.5470	0.5515	0.5562 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type (Uw = 1.20)			30.1000	1.1450	34.4656		(27)
19			2.5000	1.5918	3.9794		(27a)
16-18			6.0000	2.0221	12.1324		(27a)
Floor 1 P/a 0.35			103.9300	0.1300	13.5109		(28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1800	15.8670		(29a)
External Wall 3 "attic"	15.9000		15.9000	0.1800	2.8620		(29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1800	13.4388		(29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1100	5.8366		(30)
External Roof 3 "attic"	32.7800		32.7800	0.1100	3.6058		(30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1100	2.1593		(30)
Total net area of external elements Aum(A, m2)			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.9578	(33)
Party Wall 1			32.6200	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 115.1995 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	21.0700	0.0900	1.8963
E5 Ground floor (normal)	35.9500	0.1600	5.7520
E11 Eaves (insulation at rafter level)	23.0400	0.0400	0.9216
R4 Ridge (vaulted ceiling)	19.9000	0.0800	1.5920
E13 Gable (insulation at rafter level)	24.4900	0.0800	1.9592
E6 Intermediate floor within a dwelling	17.5100	0.0000	0.0000
R7 Flat ceiling (inverted)	18.3500	0.0400	0.7340
E14 Flat roof	11.1800	0.0800	0.8944
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0900	-0.4770
P1 Party wall - Ground floor	6.9000	0.0800	0.5520
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0800	0.6960
E18 Party wall between dwellings	8.7900	0.0600	0.5274
E2 Other lintels (including other steel lintels)	26.6400	0.0500	1.3320
E3 Sill	25.6400	0.0500	1.2820
E4 Jamb	37.9200	0.0500	1.8960
R1 Head of roof window	2.5000	0.0800	0.2000
R2 Sill of roof window	2.5000	0.0600	0.1500
R3 Jamb of roof window	2.0000	0.0800	0.1600
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.5079 (36)

#### Point Thermal bridges

Total fabric heat loss (33) + (36) + (36a) = 131.4657 (37)

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

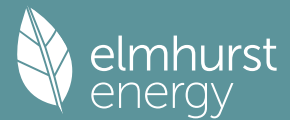
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	87.2112	86.8154	86.4274	84.6049	84.2640	82.6767	82.6767	82.3827	83.2881	84.2640	84.9537	85.6749 (38)
Heat transfer coeff	218.6769	218.2811	217.8931	216.0706	215.7297	214.1424	214.1424	213.8485	214.7538	215.7297	216.4194	217.1406 (39)
Average = Sum(39)m / 12 =												216.0690

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1.3239	1.3215	1.3191	1.3081	1.3060	1.2964	1.2964	1.2946	1.3001	1.3060	1.3102	1.3146 (40)
HLP (average)												1.3081
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													2.9561 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	31.8525	31.3794	30.7133	29.4850	28.5653	27.5454	26.9946	27.6561	28.3763	29.4676	30.7212	31.7448 (42b)	
Hot water usage for other uses	44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031 (42c)	
Average daily hot water use (litres/day)													70.3532 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	76.7555	74.6497	72.3507	69.4895	66.9370	64.2843	63.7335	66.0278	68.3809	71.1050	73.9914	76.6479 (44)	
Energy conte	121.5620	106.3001	111.2003	95.1277	90.1100	79.0451	77.0801	81.7562	84.3205	96.4888	105.4143	120.0120 (45)	
Energy content (annual)													Total = Sum(45)m = 1168.4171
Distribution loss (46)m = 0.15 x (45)m													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	0.0000 (56)

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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 (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 (59)
Total heat required for water heating calculated for each month											
WWHRS	103.3277	90.3551	94.5202	80.8586	76.5935	67.1883	65.5181	69.4928	71.6724	82.0155	89.6022 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	103.3277	90.3551	94.5202	80.8586	76.5935	67.1883	65.5181	69.4928	71.6724	82.0155	89.6022 (64)
Total per year (kWh/year) = Sum(64)m =											993 (64)
12Total per year (kWh/year)											
Electric shower(s)	59.0882	52.6480	57.4897	54.8617	55.8911	53.3147	55.0919	55.8911	54.8617	57.4897	56.4086 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											672.1245 (64a)
Heat gains from water heating, kWh/month											
	40.6040	35.7508	38.0025	33.9301	33.1212	30.1258	30.1525	31.3460	31.6335	34.8763	36.5027 (65)

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

Metabolic gains (Table 5), Watts											
(66)m	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033	147.8033 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
	169.7765	187.9668	169.7765	175.4357	169.7765	175.4357	169.7765	169.7765	175.4357	169.7765	175.4357 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
	336.6009	340.0937	331.2918	312.5536	288.9000	266.6689	251.8172	248.3243	257.1262	275.8645	299.5181 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803	37.7803 (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 (70)
Losses e.g. evaporation (negative values) (Table 5)											
	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)
Water heating gains (Table 5)											
	54.5752	53.2006	51.0786	47.1251	44.5177	41.8413	40.5275	42.1317	43.9354	46.8767	50.6982 (72)
Total internal gains											
	628.2936	648.6021	619.4879	602.4554	570.5352	551.2870	529.4622	527.5735	543.8384	559.8587	592.9930 (73)

## 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains					
		m2	Table 6a	Specific data	Specific data	factor	W					
			W/m2	or Table 6b	or Table 6c	Table 6d						
North		1.9200	10.6334	0.6300	0.7000	0.7700	6.2394 (74)					
East		9.8000	19.6403	0.6300	0.7000	0.7700	58.8227 (76)					
West		18.3800	19.6403	0.6300	0.7000	0.7700	110.3226 (80)					
Horizontal		2.5000	26.0000	0.6300	0.7000	1.0000	25.7985 (82)					
North		6.0000	26.0000	0.6300	0.7000	1.0000	61.9164 (82)					
Solar gains	263.0997	524.9852	889.0512	1333.3249	1665.5564	1718.6994	1630.6571	1379.7923	1046.0943	629.4767	329.9320	215.1451 (83)
Total gains	891.3933	1173.5873	1508.5391	1935.7804	2236.0916	2269.9864	2160.1193	1907.3658	1589.9327	1189.3354	922.9250	828.1442 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	24.1714	24.2153	24.2584	24.4630	24.5017	24.6833	24.6833	24.7172	24.6130	24.5017	24.4236	24.3425 (85)
alpha	2.6114	2.6144	2.6172	2.6309	2.6334	2.6456	2.6456	2.6478	2.6409	2.6334	2.6282	2.6228
util living area	0.9809	0.9614	0.9189	0.8227	0.6844	0.5289	0.4074	0.4682	0.6993	0.9019	0.9685	0.9841 (86)
MIT	18.0226	18.4404	19.0965	19.8995	20.4872	20.8163	20.9328	20.9020	20.6006	19.7380	18.7241	17.9546 (87)
Th 2	19.8222	19.8241	19.8259	19.8345	19.8361	19.8436	19.8436	19.8450	19.8407	19.8361	19.8328	19.8294 (88)
util rest of house	0.9774	0.9545	0.9045	0.7923	0.6325	0.4526	0.3105	0.3665	0.6281	0.8777	0.9618	0.9812 (89)
MIT 2	17.1175	17.5312	18.1736	18.9417	19.4687	19.7404	19.8179	19.8044	19.5879	18.8137	17.8222	17.0547 (90)
Living area fraction	17.3722	17.7871	18.4334	19.2113	19.7553	20.0432	20.1317	20.1133	19.8729	19.0738	18.0760	17.3080 (92)
MIT	17.3722	17.7871	18.4334	19.2113	19.7553	20.0432	20.1317	20.1133	19.8729	19.0738	18.0760	17.3080 (92)
Temperature adjustment												0.0000
adjusted MIT	17.3722	17.7871	18.4334	19.2113	19.7553	20.0432	20.1317	20.1133	19.8729	19.0738	18.0760	17.3080 (93)

## 8. Space heating requirement

Utilisation	0.9667	0.9381	0.8826	0.7734	0.6285	0.4665	0.3356	0.3914	0.6303	0.8575	0.9473	0.9719 (94)
Useful gains	861.6991	1100.9237	1331.5013	1497.0580	1405.4448	1058.9974	725.0047	746.6059	1002.1578	1019.8113	874.3122	804.8377 (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	2858.5959	2813.0063	2600.1949	2227.9620	1737.7720	1165.6299	756.2852	794.0853	1239.7550	1828.0599	2375.4237	2846.2798 (97)
Space heating kWh	1485.6912	1150.5195	943.9081	526.2509	247.2514	0.0000	0.0000	0.0000	0.0000	601.3370	1080.8003	1518.8329 (98a)
Space heating requirement - total per year (kWh/year)												7554.5913
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	1485.6912	1150.5195	943.9081	526.2509	247.2514	0.0000	0.0000	0.0000	0.0000	601.3370	1080.8003	1518.8329 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7554.5913
Space heating per m2												(98c) / (4) = 45.7355 (99)

## 8c. Space cooling requirement

# Full SAP Calculation Printout



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2012.9385	1584.6537	1625.2482	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7945	0.8489	0.8071	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1599.1888	1345.1602	1311.7107	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	2464.4772	2345.5517	2071.7633	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	623.0076	744.2913	565.4791	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	155.7519	186.0728	141.3698	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement									0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												483.1945 (107)
Energy for space cooling												45.7355 (99)
Total												2.9253 (108)
Fabric Energy Efficiency (TFEE)												48.6608 (109)
												48.7 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	466.7720 (5)

## 2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	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	0.9500	(17)
Infiltration rate	0.0475	(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) =	0.0404 (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	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (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 = 0.90)			30.1000	0.8687	26.1486		(27)
Door			2.1000	0.9000	1.8900		(26a)
16-18			6.0000	1.2357	7.4144		(27a)
19			2.5000	1.2357	3.0894		(27a)
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000 (28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500 (29a)
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000 (29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400 (29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400 (30)
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200 (30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	90.2786		(33)
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000 (32)
Internal Wall 1 GF			168.5800			9.0000	1517.2200 (32c)
Internal Wall 2 FF			135.0400			9.0000	1215.3600 (32c)

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Internal Floor 1 61.2500 18.0000 1102.5000 (32d)  
 Internal Ceiling 1 61.2500 9.0000 551.2500 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19028.6500 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 115.1995 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	21.0700	0.0300	0.6321
E5 Ground floor (normal)	35.9500	0.0210	0.7550
E11 Eaves (insulation at rafter level)	23.0400	0.0390	0.8986
R4 Ridge (vaulted ceiling)	19.9000	0.1200	2.3880
E13 Gable (insulation at rafter level)	24.4900	0.0240	0.5878
E6 Intermediate floor within a dwelling	17.5100	0.0800	1.4008
R7 Flat ceiling (inverted)	18.3500	0.1200	2.2020
E14 Flat roof	11.1800	0.0460	0.5143
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0150	-0.0795
P1 Party wall - Ground floor	6.9000	0.1490	1.0281
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0810	0.7047
E18 Party wall between dwellings	8.7900	0.0395	0.3472
E2 Other lintels (including other steel lintels)	26.6400	0.0840	2.2378
E3 Sill	25.6400	0.0430	1.1025
E4 Jamb	37.9200	0.0340	1.2893
R1 Head of roof window	2.5000	0.2400	0.6000
R2 Sill of roof window	2.5000	0.2400	0.6000
R3 Jamb of roof window	2.0000	0.2400	0.4800
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.0085 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 112.2871 (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
22.5627	22.5627	22.4072	22.2518	21.4744	21.3189	20.5415	20.5415	20.3860	20.8525	21.3189	21.6298	21.9408 (38)
Heat transfer coeff	134.8498	134.6944	134.5389	133.7615	133.6060	132.8286	132.8286	132.6731	133.1396	133.6060	133.9170	134.2279 (39)
Average = Sum(39)m / 12 =												133.7226
HLP	0.8164	0.8154	0.8145	0.8098	0.8089	0.8041	0.8041	0.8032	0.8060	0.8089	0.8107	0.8126 (40)
HLP (average)												0.8096
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.9561 (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	85.1167	83.8526	82.0725	78.7903	76.3326	73.6074	72.1354	73.9030	75.8277	78.7437	82.0936	84.8289 (42b)
Hot water usage for other uses	44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031 (42c)
Average daily hot water use (litres/day)												119.7376 (43)
Daily hot water use	130.0198	127.1228	123.7099	118.7948	114.7043	110.3462	108.8742	112.2747	115.8323	120.3811	125.3638	129.7320 (44)
Energy content (annual)	205.9195	181.0212	190.1375	162.6242	154.4140	135.6836	131.6740	139.0196	142.8328	163.3561	178.6037	203.1290 (45)
Distribution loss (46)m = 0.15 x (45)m	30.8879	27.1532	28.5206	24.3936	23.1621	20.3525	19.7511	20.8529	21.4249	24.5034	26.7906	30.4693 (46)
Water storage loss:												250.0000 (47)
Store volume												1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8640 (55)
Enter (49) or (54) in (55)												
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (64)
Total per year (kWh/year) = Sum(64)m =												2577.6710 (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	108.5054	96.3521	103.2578	92.8181	91.3798	83.8604	83.8187	86.2611	86.2375	94.3530	98.1313	107.5775 (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	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.5072	33.3135	27.0924	20.5107	15.3320	12.9439	13.9863	18.1800	24.4011	30.9828	36.1615	38.5496 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	502.3894	507.6026	494.4654	466.4980	431.1940	398.0133	375.8466	370.6333	383.7705	411.7380	447.0419	480.2226 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925 (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)	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)
Water heating gains (Table 5)	145.8405	143.3811	138.7874	128.9141	122.8223	116.4728	112.6596	115.9424	119.7743	126.8186	136.2935	144.5934 (72)
Total internal gains	800.5509	799.1110	775.1590	730.7365	684.1621	642.2438	617.3062	619.5695	642.7597	684.3532	734.3107	778.1794 (73)

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## 6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			
North		1.9200	10.6334	0.6800	0.7000	0.7000	0.7700	6.7346 (74)				
East		9.8000	19.6403	0.6800	0.7000	0.7700	0.7700	63.4912 (76)				
West		18.3800	19.6403	0.6800	0.7000	0.7700	0.7700	119.0784 (80)				
North		6.0000	26.0000	0.7600	0.7000	1.0000	1.0000	74.6928 (82)				
Horizontal		2.5000	26.0000	0.7600	0.7000	1.0000	1.0000	31.1220 (82)				
Solar gains	295.1190	589.7843	1000.7372	1503.4044	1879.9962	1940.7841	1841.0419	1556.5584	1178.3837	707.7096	370.2543	241.2165 (83)
Total gains	1095.6699	1388.8953	1775.8962	2234.1409	2564.1583	2583.0279	2458.3482	2176.1279	1821.1434	1392.0628	1104.5650	1019.3959 (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	39.1972	39.2424	39.2878	39.5161	39.5621	39.7937	39.7937	39.8403	39.7007	39.5621	39.4702	39.3788	
alpha	3.6131	3.6162	3.6192	3.6344	3.6375	3.6529	3.6529	3.6560	3.6467	3.6375	3.6313	3.6253	
util living area	0.9606	0.9177	0.8187	0.6447	0.4660	0.3253	0.2368	0.2785	0.4829	0.7836	0.9329	0.9684 (86)	
Living	19.7765	20.0662	20.4431	20.7457	20.8700	20.9062	20.9134	20.9117	20.8782	20.6312	20.1251	19.7104	
Non living	18.7868	19.1487	19.6079	19.9613	20.0952	20.1343	20.1402	20.1400	20.1091	19.8436	19.2308	18.7059	
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	20.3741	20.0662	20.4431	20.7457	20.8700	20.9062	20.9134	20.9117	20.8782	20.6312	20.1251	19.8908 (87)	
Th 2	20.2392	20.2400	20.2408	20.2449	20.2457	20.2497	20.2497	20.2506	20.2481	20.2457	20.2440	20.2424 (88)	
util rest of house	0.9550	0.9072	0.7990	0.6151	0.4319	0.2883	0.1968	0.2339	0.4357	0.7531	0.9225	0.9639 (89)	
MIT 2	19.6601	19.1487	19.6079	19.9613	20.0952	20.1343	20.1402	20.1400	20.1091	19.8436	19.2308	18.9828 (90)	
Living area fraction										FLA = Living area / (4) =		0.2815 (91)	
MIT	19.8611	19.4070	19.8429	20.1821	20.3133	20.3516	20.3578	20.3572	20.3255	20.0652	19.4825	19.2384 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.8611	19.4070	19.8429	20.1821	20.3133	20.3516	20.3578	20.3572	20.3255	20.0652	19.4825	19.2384 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9519	0.8939	0.7877	0.6126	0.4350	0.2933	0.2026	0.2402	0.4407	0.7452	0.9099	0.9566 (94)
Useful gains	1043.0026	1241.5304	1398.8998	1368.6249	1115.5189	757.6655	497.9676	522.8052	802.5968	1037.4086	1005.0687	975.1212 (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	2098.4109	1954.0066	1795.1442	1509.1041	1150.7842	763.9709	499.1440	525.0091	828.8667	1264.6137	1658.2217	2018.5675 (97)
Space heating kWh	785.2238	478.7840	294.8059	101.1450	26.2373	0.0000	0.0000	0.0000	0.0000	169.0406	470.2702	776.3240 (98a)
Space heating requirement - total per year (kWh/year)												3101.8308
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	785.2238	478.7840	294.8059	101.1450	26.2373	0.0000	0.0000	0.0000	0.0000	169.0406	470.2702	776.3240 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3101.8308
Space heating per m <sup>2</sup>										(98c) / (4) =		18.7785 (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 %)													363.3460 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	785.2238	478.7840	294.8059	101.1450	26.2373	0.0000	0.0000	0.0000	0.0000	169.0406	470.2702	776.3240 (98)	
Space heating efficiency (main heating system 1)	363.3460	363.3460	363.3460	363.3460	363.3460	0.0000	0.0000	0.0000	0.0000	363.3460	363.3460	363.3460 (210)	
Space heating fuel (main heating system)	216.1091	131.7708	81.1364	27.8371	7.2210	0.0000	0.0000	0.0000	0.0000	46.5233	129.4277	213.6597 (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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (64)	
Efficiency of water heater (217)m	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274 (216)	
Fuel for water heating, kWh/month	129.3232	114.2967	121.3495	106.6331	103.3007	93.0218	91.8116	95.5229	96.6338	107.8186	114.7066	127.9133 (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	40.4334	36.5204	40.4334	39.1290	40.4334	39.1290	40.4334	40.4334	39.1290	40.4334	39.1290	40.4334 (231)	
Lighting	32.8298	26.3373	23.7138	17.3737	13.4200	10.9642	12.2422	15.9128	20.6692	27.1191	30.6309	33.7422 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-97.3594	-134.4714	-186.8402	-199.6389	-208.4815	-192.1259	-189.8560	-181.5816	-164.5027	-146.6841	-105.0483	-84.1912 (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)	

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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	-52.9001	-116.2686	-240.1985	-372.6772	-498.5668	-503.0153	-496.0986	-417.7403	-304.8866	-173.8535	-73.1811	-41.5503	(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												853.6852	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												197.9274	
Water heating fuel used												1302.3317	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360) mechanical ventilation fans (SFP = 0.8360)												476.0701	(230a)
Total electricity for the above, kWh/year												476.0701	(231)
Electricity for lighting (calculated in Appendix L)												264.9553	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5181.7182	(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												-2284.6759	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	853.6852	16.4900	140.7727	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1302.3317	16.4900	214.7545	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	476.0701	16.4900	78.5040	(249)
Energy for lighting	264.9553	16.4900	43.6911	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1890.7813	16.4900	-311.7898	
PV Unit electricity exported	-3290.9369	5.5900	-183.9634	
Total			-495.7532	(252)
Total energy cost			-18.0309	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.0309	(257)
SAP value		100.5006	
SAP rating (Section 12)		101	(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	853.6852	0.1574	134.3541	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1302.3317	0.1409	183.4933	(264)
Space and water heating			317.8475	(265)
Pumps, fans and electric keep-hot	476.0701	0.1387	66.0368	(267)
Energy for lighting	264.9553	0.1443	38.2412	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1890.7813	0.1355	-256.1096	
PV Unit electricity exported	-3290.9369	0.1251	-411.7218	
Total			-667.8314	(269)
Total CO2, kg/year			-245.7059	(272)
CO2 emissions per m2			-1.4900	(273)
EI value			101.5665	
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

## 1. Overall dwelling characteristics

Area (m2)	Storey height (m)	Volume (m3)
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Ground floor				103.9300 (1b)	x	2.9000 (2b)	=	301.3970 (1b)	-	(3b)
First floor				61.2500 (1c)	x	2.7000 (2c)	=	165.3750 (1c)	-	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)			165.1800							(4)
Dwelling volume								(3a) + (3b) + (3c) + (3d) + (3e) ... (3n)	=	466.7720 (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					0.9500	(17)					
Infiltration rate					0.0475	(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) =			0.0404	(21)					

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.8000	5.5000	5.4000	4.9000	4.8000	4.2000	4.2000	4.1000	4.4000	5.0000	5.1000	5.6000	(22)
Wind factor	1.4500	1.3750	1.3500	1.2250	1.2000	1.0500	1.0500	1.0250	1.1000	1.2500	1.2750	1.4000	(22a)
Adj infilt rate													
	0.0585	0.0555	0.0545	0.0495	0.0485	0.0424	0.0424	0.0414	0.0444	0.0505	0.0515	0.0565	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													81.0000 (23c)
Effective ac	0.1535	0.1505	0.1495	0.1445	0.1434	0.1374	0.1374	0.1364	0.1394	0.1455	0.1465	0.1515	(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 = 0.90)			30.1000	0.8687	26.1486			(27)
Door			2.1000	0.9000	1.8900			(26a)
16-18			6.0000	1.2357	7.4144			(27a)
19			2.5000	1.2357	3.0894			(27a)
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000	(28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500	(29a)
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000	(29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400	(29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400	(30)
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200	(30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700	(30)
Total net area of external elements Aum(A, m2)			428.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	90.2786			(33)
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000	(32)
Internal Wall 1 GF			168.5800			9.0000	1517.2200	(32c)
Internal Wall 2 FF			135.0400			9.0000	1215.3600	(32c)
Internal Floor 1			61.2500			18.0000	1102.5000	(32d)
Internal Ceiling 1			61.2500			9.0000	551.2500	(32e)
Heat capacity Cm = Sum(A x k)							(28) ... (30) + (32) + (32a) ... (32e) =	19028.6500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								115.1995 (35)

List of Thermal Bridges	K1 Element	Length	Psi-value	Total	
E16 Corner (normal)		21.0700	0.0300	0.6321	
E5 Ground floor (normal)		35.9500	0.0210	0.7550	
E11 Eaves (insulation at rafter level)		23.0400	0.0390	0.8986	
R4 Ridge (vaulted ceiling)		19.9000	0.1200	2.3880	
E13 Gable (insulation at rafter level)		24.4900	0.0240	0.5878	
E6 Intermediate floor within a dwelling		17.5100	0.0800	1.4008	
R7 Flat ceiling (inverted)		18.3500	0.1200	2.2020	
E14 Flat roof		11.1800	0.0460	0.5143	
E17 Corner (inverted - internal area greater than external area)		5.3000	-0.0150	-0.0795	
P1 Party wall - Ground floor		6.9000	0.1490	1.0281	
P2 Party wall - Intermediate floor within a dwelling		6.9000	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)		8.7000	0.0810	0.7047	
E18 Party wall between dwellings		8.7900	0.0395	0.3472	
E2 Other lintels (including other steel lintels)		26.6400	0.0840	2.2378	
E3 Sill		25.6400	0.0430	1.1025	
E4 Jamb		37.9200	0.0340	1.2893	
R1 Head of roof window		2.5000	0.2400	0.6000	
R2 Sill of roof window		2.5000	0.2400	0.6000	
R3 Jamb of roof window		2.0000	0.2400	0.4800	
R11 Upstands or kerbs of rooflights		18.0000	0.2400	4.3200	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					22.0085 (36)
Point Thermal bridges					(36a) = 0.0000
Total fabric heat loss					(33) + (36) + (36a) = 112.2871 (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	23.6511	23.1846	23.0292	22.2518	22.0963	21.1634	21.1634	21.0079	21.4744	22.4072	22.5627	23.3401	(38)
Heat transfer coeff													
	135.9382	135.4718	135.3163	134.5389	134.3834	133.4505	133.4505	133.2951	133.7615	134.6944	134.8498	135.6272	(39)
Average = Sum(39)m / 12 =													134.5648
HLP	0.8230	0.8201	0.8192	0.8145	0.8136	0.8079	0.8079	0.8070	0.8098	0.8154	0.8164	0.8211	(40)
HLP (average)													0.8147

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
<b>4. Water heating energy requirements (kWh/year)</b>												
Assumed occupancy												2.9561 (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	85.1167	83.8526	82.0725	78.7903	76.3326	73.6074	72.1354	73.9030	75.8277	78.7437	82.0936	84.8289 (42b)
Hot water usage for other uses	44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031 (42c)
Average daily hot water use (litres/day)												119.7376 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	130.0198	127.1228	123.7099	118.7948	114.7043	110.3462	108.8742	112.2747	115.8323	120.3811	125.3638	129.7320 (44)
Energy content (annual)	205.9195	181.0212	190.1375	162.6242	154.4140	135.6836	131.6740	139.0196	142.8328	163.3561	178.6037	203.1290 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1988.4150
Water storage loss:	30.8879	27.1532	28.5206	24.3936	23.1621	20.3525	19.7511	20.8529	21.4249	24.5034	26.7906	30.4693 (46)
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month	108.5054	96.3521	103.2578	92.8181	91.3798	83.8604	83.8187	86.2611	86.2375	94.3530	98.1313	107.5775 (65)
<b>5. Internal gains (see Table 5 and 5a)</b>												
Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.5072	33.3135	27.0924	20.5107	15.3320	12.9439	13.9863	18.1800	24.4011	30.9828	36.1615	38.5496 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	502.3894	507.6026	494.4654	466.4980	431.1940	398.0133	375.8466	370.6333	383.7705	411.7380	447.0419	480.2226 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925 (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)	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426 (71)
Water heating gains (Table 5)	145.8405	143.3811	138.7874	128.9141	122.8223	116.4728	112.6596	115.9424	119.7743	126.8186	136.2935	144.5934 (72)
Total internal gains	800.5509	799.1110	775.1590	730.7365	684.1621	642.2438	617.3062	619.5695	642.7597	684.3532	734.3107	778.1794 (73)
<b>6. Solar gains</b>												
[Jan]	Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
North	1.9200		14.1962		0.6800		0.7000		0.7700		8.9911 (74)	
East	9.8000		26.5726		0.6800		0.7000		0.7700		85.9016 (76)	
West	18.3800		26.5726		0.6800		0.7000		0.7700		161.1092 (80)	
North	6.0000		36.0000		0.7600		0.7000		1.0000		103.4208 (82)	
Horizontal	2.5000		36.0000		0.7600		0.7000		1.0000		43.0920 (82)	
Solar gains	402.5147	678.8054	1113.3344	1699.4394	1974.9819	2181.0814	1849.5850	1712.1013	1339.0268	815.2357	475.4308	339.3112 (83)
Total gains	1203.0656	1477.9165	1888.4934	2430.1759	2659.1439	2823.3252	2466.8912	2331.6708	1981.7865	1499.5888	1209.7416	1117.4906 (84)
<b>7. Mean internal temperature (heating season)</b>												
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	38.8834	39.0173	39.0621	39.2878	39.3332	39.6082	39.6082	39.6544	39.5161	39.2424	39.1972	38.9725
alpha	3.5922	3.6012	3.6041	3.6192	3.6222	3.6405	3.6405	3.6436	3.6344	3.6162	3.6131	3.5982
util living area	0.9369	0.8891	0.7784	0.6045	0.4577	0.3224	0.2793	0.2892	0.4498	0.7265	0.8933	0.9452 (86)
Living	19.9995	20.2211	20.5378	20.7769	20.8710	20.9053	20.9106	20.9102	20.8851	20.7087	20.3279	19.9750
Non living	19.0631	19.3372	19.7164	19.9907	20.0919	20.1299	20.1348	20.1354	20.1117	19.9254	19.4774	19.0348
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	20.4882	20.2211	20.5378	20.7769	20.8710	20.9053	20.9106	20.9102	20.8851	20.7087	20.3279	20.1184 (87)
Th 2	20.2335	20.2359	20.2367	20.2408	20.2416	20.2465	20.2465	20.2473	20.2449	20.2400	20.2392	20.2351 (88)

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util rest of house	0.9279	0.8751	0.7554	0.5748	0.4242	0.2882	0.2395	0.2474	0.4047	0.6906	0.8768	0.9371 (89)
MIT 2	19.7669	19.3372	19.7164	19.9907	20.0919	20.1299	20.1348	20.1354	20.1117	19.9254	19.4774	19.2511 (90)
Living area fraction									FLA = Living area / (4) =			0.2815 (91)
MIT	19.9699	19.5860	19.9476	20.2120	20.3112	20.3481	20.3531	20.3535	20.3294	20.1459	19.7168	19.4952 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9699	19.5860	19.9476	20.2120	20.3112	20.3481	20.3531	20.3535	20.3294	20.1459	19.7168	19.4952 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9245	0.8616	0.7461	0.5736	0.4273	0.2929	0.2452	0.2533	0.4098	0.6859	0.8638	0.9278	(94)
Useful gains	1112.2425	1273.3271	1408.9138	1393.9539	1136.3067	826.8643	604.8238	590.5948	812.1513	1028.5721	1044.9860	1036.7911	(95)
Ext temp.	5.6000	5.9000	7.2000	9.0000	11.6000	14.1000	15.8000	15.9000	14.1000	11.3000	8.4000	5.9000	(96)
Heat loss rate W	1953.4176	1854.0607	1724.9584	1508.4489	1170.6360	833.8179	607.6172	593.6272	833.2474	1191.4868	1526.0654	1843.8813	(97)
Space heating kWh	625.8343	390.2529	235.1372	82.4364	25.5410	0.0000	0.0000	0.0000	0.0000	121.2086	346.3772	600.4751	(98a)
Space heating requirement - total per year (kWh/year)												2427.2627	
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	625.8343	390.2529	235.1372	82.4364	25.5410	0.0000	0.0000	0.0000	0.0000	121.2086	346.3772	600.4751	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2427.2627	
Space heating per m2										(98c) / (4) =		14.6947	(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 %)													364.6798	(206)	
Efficiency of main space heating system 2 (in %)													0.0000	(207)	
Efficiency of secondary/supplementary heating system, %													65.0000	(208)	
Space heating requirement	625.8343	390.2529	235.1372	82.4364	25.5410	0.0000	0.0000	0.0000	0.0000	121.2086	346.3772	600.4751	(98)		
Space heating efficiency (main heating system 1)	364.6798	364.6798	364.6798	364.6798	364.6798	0.0000	0.0000	0.0000	0.0000	364.6798	364.6798	364.6798	(210)		
Space heating fuel (main heating system)	171.6120	107.0125	64.4777	22.6051	7.0037	0.0000	0.0000	0.0000	0.0000	33.2370	94.9812	164.6582	(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	255.9659	226.2244	240.1839	211.0562	204.4604	184.1156	181.7204	189.0660	191.2648	213.4025	227.0357	253.1754	(64)		
Efficiency of water heater (217)m	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	(216)		
Fuel for water heating, kWh/month	129.2885	114.2661	121.3170	106.6046	103.2730	92.9969	91.7870	95.4973	96.6079	107.7897	114.6758	127.8790	(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	40.4334	36.5204	40.4334	39.1290	40.4334	39.1290	40.4334	40.4334	39.1290	40.4334	39.1290	40.4334	(231)		
Lighting	32.8298	26.3373	23.7138	17.3737	13.4200	10.9642	12.2422	15.9128	20.6692	27.1191	30.6309	33.7422	(232)		
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-118.7481	-143.1521	-193.6471	-208.1557	-211.3488	-198.9355	-189.4824	-187.1930	-172.5942	-155.2852	-120.9047	-105.5349	(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	-80.0655	-137.3677	-270.4148	-428.0393	-522.9124	-575.0627	-492.6336	-462.5746	-349.7741	-204.1931	-101.2101	-65.9985	(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													665.5875	(211)	
Space heating fuel - main system 2													0.0000	(213)	
Space heating fuel - secondary													0.0000	(215)	
Efficiency of water heater													197.9804		
Water heating fuel used													1301.9829	(219)	
Space cooling fuel													0.0000	(221)	
Electricity for pumps and fans:															
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)															
mechanical ventilation fans (SFP = 0.8360)														476.0701	(230a)
Total electricity for the above, kWh/year														476.0701	(231)
Electricity for lighting (calculated in Appendix L)														264.9553	(232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation														-5695.2282	(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														-2986.6325	(238)

## 10a. Fuel costs - using BEDF prices (536)

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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	665.5875	25.1600	167.4618 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1301.9829	25.1600	327.5789 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	476.0701	25.1600	119.7792 (249)
Energy for lighting	264.9553	25.1600	66.6627 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2004.9818	25.1600	-504.4534
PV Unit electricity exported	-3690.2464	5.8100	-214.4033
Total			-718.8567 (252)
Total energy cost			-37.3741 (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	665.5875	0.1575	104.8186 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1301.9829	0.1409	183.4442 (264)
Space and water heating			288.2627 (265)
Pumps, fans and electric keep-hot	476.0701	0.1387	66.0368 (267)
Energy for lighting	264.9553	0.1443	38.2412 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2004.9818	0.1362	-273.0571
PV Unit electricity exported	-3690.2464	0.1269	-468.1194
Total			-741.1765 (269)
Total CO2, kg/year			-348.6357 (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	665.5875	1.5829	1053.5757 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1301.9829	1.5210	1980.2925 (278)
Space and water heating			3033.8681 (279)
Pumps, fans and electric keep-hot	476.0701	1.5128	720.1988 (281)
Energy for lighting	264.9553	1.5338	406.3973 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2004.9818	1.5034	-3014.2938
PV Unit electricity exported	-3690.2464	0.4657	-1718.6040
Total			-4732.8978 (283)
Total Primary energy kWh/year			-572.4336 (286)

## SAP 10 EPC IMPROVEMENTS

### SEC1 - ASHP ROI

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

	Recommended
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	+ 1.0	-£ 61	-38 kg (10.8%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£61	0.23 kg/m <sup>2</sup>	A 101	A 102
<b>Total Savings</b>	<b>£61</b>	<b>0.23 kg/m<sup>2</sup></b>		

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

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£681	£605	£77
Space heating	£287	£307	-£20
Water heating	£328	£231	£97
Lighting	£67	£67	£0
Generated (PV)	-£719	-£703	-£16
Total cost of fuels	-£138	-£198	£61
Total cost of uses	-£137	-£198	£61
Delivered energy	-18 kWh/m <sup>2</sup>	-20 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.3 tonnes	-0.4 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	-2 kg/m <sup>2</sup>	-2 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	-3 kWh/m <sup>2</sup>	-6 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 466.7720 (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												0.9500 (17)	
Infiltration rate												0.0475 (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) =											0.0404 (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	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)	
If mechanical ventilation												0.5000 (23a)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)	
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (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 = 0.90)			30.1000	0.8687	26.1486		(27)
Door			2.1000	0.9000	1.8900		(26a)
16-18			6.0000	1.2357	7.4144		(27a)
19			2.5000	1.2357	3.0894		(27a)
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000 (28a)
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500 (29a)
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000 (29a)
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400 (29a)
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400 (30)
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200 (30)
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			428.8100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	90.2786			(33)
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000 (32)
Internal Wall 1 GF			168.5800			9.0000	1517.2200 (32c)
Internal Wall 2 FF			135.0400			9.0000	1215.3600 (32c)
Internal Floor 1			61.2500			18.0000	1102.5000 (32d)
Internal Ceiling 1			61.2500			9.0000	551.2500 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	19028.6500 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K				115.1995 (35)			

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	21.0700	0.0300	0.6321
E5 Ground floor (normal)	35.9500	0.0210	0.7550
E11 Eaves (insulation at rafter level)	23.0400	0.0390	0.8986
R4 Ridge (vaulted ceiling)	19.9000	0.1200	2.3880
E13 Gable (insulation at rafter level)	24.4900	0.0240	0.5878
E6 Intermediate floor within a dwelling	17.5100	0.0800	1.4008
R7 Flat ceiling (inverted)	18.3500	0.1200	2.2020
E14 Flat roof	11.1800	0.0460	0.5143
E17 Corner (inverted - internal area greater than external area)	5.3000	-0.0150	-0.0795
P1 Party wall - Ground floor	6.9000	0.1490	1.0281
P2 Party wall - Intermediate floor within a dwelling	6.9000	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.7000	0.0810	0.7047
E18 Party wall between dwellings	8.7900	0.0395	0.3472
E2 Other lintels (including other steel lintels)	26.6400	0.0840	2.2378
E3 Sill	25.6400	0.0430	1.1025
E4 Jamb	37.9200	0.0340	1.2893
R1 Head of roof window	2.5000	0.2400	0.6000
R2 Sill of roof window	2.5000	0.2400	0.6000
R3 Jamb of roof window	2.0000	0.2400	0.4800



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North	1.9200	10.6334	0.6800	0.7000	0.7700	6.7346 (74)
East	9.8000	19.6403	0.6800	0.7000	0.7700	63.4912 (76)
West	18.3800	19.6403	0.6800	0.7000	0.7700	119.0784 (80)
North	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)
Horizontal	2.5000	26.0000	0.7600	0.7000	1.0000	31.1220 (82)

Solar gains	295.1190	589.7843	1000.7372	1503.4044	1879.9962	1940.7841	1841.0419	1556.5584	1178.3837	707.7096	370.2543	241.2165 (83)
Total gains	1095.6699	1388.8953	1774.3954	2226.6369	2550.4009	2569.0204	2444.3407	2163.1210	1815.1402	1390.5620	1104.5650	1019.3959 (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	39.1972	39.2424	39.2878	39.5161	39.5621	39.7937	39.7937	39.8403	39.7007	39.5621	39.4702	39.3788	
alpha	3.6131	3.6162	3.6192	3.6344	3.6375	3.6529	3.6529	3.6560	3.6467	3.6375	3.6313	3.6253	
util living area	0.9606	0.9177	0.8190	0.6462	0.4683	0.3270	0.2381	0.2801	0.4843	0.7841	0.9329	0.9684 (86)	
Living	19.7765	20.0662	20.4424	20.7444	20.8693	20.9060	20.9133	20.9116	20.8778	20.6306	20.1251	19.7104	
Non living	18.7868	19.1487	19.6071	19.9598	20.0945	20.1342	20.1402	20.1399	20.1088	19.8430	19.2308	18.7059	
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	20.3741	20.0662	20.4424	20.7444	20.8693	20.9060	20.9133	20.9116	20.8778	20.6306	20.1251	19.8908 (87)	
Th 2	20.2392	20.2400	20.2408	20.2449	20.2457	20.2497	20.2497	20.2506	20.2481	20.2457	20.2440	20.2424 (88)	
util rest of house	0.9550	0.9072	0.7993	0.6167	0.4341	0.2898	0.1979	0.2352	0.4371	0.7536	0.9225	0.9639 (89)	
MIT 2	19.6601	19.1487	19.6071	19.9598	20.0945	20.1342	20.1402	20.1399	20.1088	19.8430	19.2308	18.9828 (90)	
Living area fraction										FLA = Living area / (4) =			0.2815 (91)
MIT	19.8611	19.4070	19.8422	20.1806	20.3126	20.3514	20.3578	20.3571	20.3252	20.0646	19.4825	19.2384 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.8611	19.4070	19.8422	20.1806	20.3126	20.3514	20.3578	20.3571	20.3252	20.0646	19.4825	19.2384 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9519	0.8939	0.7880	0.6141	0.4371	0.2949	0.2037	0.2417	0.4420	0.7457	0.9099	0.9566 (94)	
Useful gains	1043.0026	1241.5304	1398.2613	1367.3350	1114.8781	757.5354	497.9405	522.7531	802.3047	1036.8853	1005.0687	975.1212 (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	2098.4109	1954.0066	1795.0447	1508.9151	1150.6938	763.9526	499.1400	525.0015	828.8250	1264.5334	1658.2217	2018.5675 (97)	
Space heating kWh	785.2238	478.7840	295.2069	101.9377	26.6469	0.0000	0.0000	0.0000	0.0000	169.3702	470.2702	776.3240 (98a)	
Space heating requirement - total per year (kWh/year)												3103.7636	
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	785.2238	478.7840	295.2069	101.9377	26.6469	0.0000	0.0000	0.0000	0.0000	169.3702	470.2702	776.3240 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3103.7636	
Space heating per m2												(98c) / (4) =	18.7902 (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 %) 363.3460 (206)  
 Efficiency of main space heating system 2 (in %) 0.0000 (207)  
 Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	785.2238	478.7840	295.2069	101.9377	26.6469	0.0000	0.0000	0.0000	0.0000	169.3702	470.2702	776.3240 (98)
Space heating efficiency (main heating system 1)	363.3460	363.3460	363.3460	363.3460	363.3460	0.0000	0.0000	0.0000	0.0000	363.3460	363.3460	363.3460 (210)
Space heating fuel (main heating system)	216.1091	131.7708	81.2468	28.0553	7.3337	0.0000	0.0000	0.0000	0.0000	46.6140	129.4277	213.6597 (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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water heating requirement	255.9659	210.0021	180.8670	125.0547	88.7444	76.7451	74.6431	94.4283	128.5901	183.3893	227.0357	253.1754 (64)
Efficiency of water heater	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274	197.9274 (216)
Fuel for water heating, kWh/month	129.3232	106.1006	91.3805	63.1821	44.8368	38.7744	37.7124	47.7085	64.9683	92.6549	114.7066	127.9133 (219)
Space cooling fuel requirement	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	47.2279	42.6574	47.2279	45.7044	47.2279	45.7044	47.2279	47.2279	45.7044	47.2279	45.7044	47.2279 (231)
Lighting	32.8298	26.3373	23.7138	17.3737	13.4200	10.9642	12.2422	15.9128	20.6692	27.1191	30.6309	33.7422 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-97.5393	-134.3389	-183.9991	-192.1665	-194.5335	-178.0421	-175.9036	-170.9572	-159.4608	-145.7898	-105.3319	-84.3385 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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)	-52.7202	-116.4010	-243.0397	-380.1496	-512.5148	-517.0991	-510.0510	-428.3648	-309.9285	-174.7478	-72.8975	-41.4031 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)

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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											854.2171	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											197.9274	
Water heating fuel used											959.2614	(219)
Space cooling fuel											0.0000	(221)

Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)												
mechanical ventilation fans (SFP = 0.8360)											476.0701	(230a)
pump for solar water heating											80.0000	(230g)
Total electricity for the above, kWh/year											556.0701	(231)
Electricity for lighting (calculated in Appendix L)											264.9553	(232)

Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											-5181.7182	(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											-2547.2143	(238)

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10a. Fuel costs - using Table 12 prices  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	854.2171	16.4900	140.8604	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	959.2614	16.4900	158.1822	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	476.0701	16.4900	78.5040	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	264.9553	16.4900	43.6911	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1822.4011	16.4900	-300.5139	
PV Unit electricity exported	-3359.3171	5.5900	-187.7858	
Total			-488.2998	(252)
Total energy cost			-53.8701	(255)

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11a. SAP rating - Individual heating systems  
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Energy cost deflator (Table 12):			0.3600	(256)
Energy cost factor (ECF)		[(255) x (256)] / [(4) + 45.0] =	-0.0923	(257)
SAP value			101.4957	
SAP rating (Section 12)			101	(258)
SAP band			A	

-----  
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	854.2171	0.1574	134.4294	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	959.2614	0.1458	139.8706	(264)
Space and water heating			274.3000	(265)
Pumps, fans and electric keep-hot	556.0701	0.1387	77.1338	(267)
Energy for lighting	264.9553	0.1443	38.2412	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1822.4011	0.1359	-247.6747	
PV Unit electricity exported	-3359.3171	0.1249	-419.5171	
Total			-667.1918	(269)
Total CO2, kg/year			-277.5168	(272)
CO2 emissions per m2			-1.6800	(273)
EI value			101.7693	
EI rating			102	(274)
EI band			A	

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	103.9300 (1b)	x 2.9000 (2b)	= 301.3970 (1b) - (3b)	
First floor	61.2500 (1c)	x 2.7000 (2c)	= 165.3750 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.1800		(4)	
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e)...(3n) =	466.7720 (5)	



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## 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												0.9500 (17)	
Infiltration rate												0.0475 (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) =	0.0404 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.8000	5.5000	5.4000	4.9000	4.8000	4.2000	4.2000	4.1000	4.4000	5.0000	5.1000	5.6000 (22)	
Wind factor	1.4500	1.3750	1.3500	1.2250	1.2000	1.0500	1.0500	1.0250	1.1000	1.2500	1.2750	1.4000 (22a)	
Adj infilt rate	0.0585	0.0555	0.0545	0.0495	0.0485	0.0424	0.0424	0.0414	0.0444	0.0505	0.0515	0.0565 (22b)	
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000 (23a)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)	
Effective ac	0.1535	0.1505	0.1495	0.1445	0.1434	0.1374	0.1374	0.1364	0.1394	0.1455	0.1465	0.1515 (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 = 0.90)			30.1000	0.8687	26.1486		(27)					
Door			2.1000	0.9000	1.8900		(26a)					
16-18			6.0000	1.2357	7.4144		(27a)					
19			2.5000	1.2357	3.0894		(27a)					
Floor 1 P/a 0.35			103.9300	0.1200	12.4716	110.0000	11432.3000 (28a)					
External Wall 1 Render	111.9700	23.8200	88.1500	0.1500	13.2225	9.0000	793.3500 (29a)					
External Wall 3 "attic"	15.9000		15.9000	0.0900	1.4310	9.0000	143.1000 (29a)					
External Wall 2 Dormers	83.0400	8.3800	74.6600	0.1600	11.9456	9.0000	671.9400 (29a)					
External Roof 1 sloping	59.0600	6.0000	53.0600	0.1300	6.8978	9.0000	477.5400 (30)					
External Roof 3 "attic"	32.7800		32.7800	0.0861	2.8232	9.0000	295.0200 (30)					
External Roof 2 Flat	22.1300	2.5000	19.6300	0.1500	2.9445	9.0000	176.6700 (30)					
Total net area of external elements Aum(A, m2)			428.8100				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		90.2786		(33)					
Party Wall 1			32.6200	0.0000	0.0000	20.0000	652.4000 (32)					
Internal Wall 1 GF			168.5800			9.0000	1517.2200 (32c)					
Internal Wall 2 FF			135.0400			9.0000	1215.3600 (32c)					
Internal Floor 1			61.2500			18.0000	1102.5000 (32d)					
Internal Ceiling 1			61.2500			9.0000	551.2500 (32e)					
Heat capacity Cm = Sum(A x k)			(28) ... (30) + (32) + (32a) ... (32e) =				19028.6500 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							115.1995 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E16 Corner (normal)				21.0700	0.0300	0.6321						
E5 Ground floor (normal)				35.9500	0.0210	0.7550						
E11 Eaves (insulation at rafter level)				23.0400	0.0390	0.8986						
R4 Ridge (vaulted ceiling)				19.9000	0.1200	2.3880						
E13 Gable (insulation at rafter level)				24.4900	0.0240	0.5878						
E6 Intermediate floor within a dwelling				17.5100	0.0800	1.4008						
R7 Flat ceiling (inverted)				18.3500	0.1200	2.2020						
E14 Flat roof				11.1800	0.0460	0.5143						
E17 Corner (inverted - internal area greater than external area)				5.3000	-0.0150	-0.0795						
P1 Party wall - Ground floor				6.9000	0.1490	1.0281						
P2 Party wall - Intermediate floor within a dwelling				6.9000	0.0000	0.0000						
P5 Party wall - Roof (insulation at rafter level)				8.7000	0.0810	0.7047						
E18 Party wall between dwellings				8.7900	0.0395	0.3472						
E2 Other lintels (including other steel lintels)				26.6400	0.0840	2.2378						
E3 Sill				25.6400	0.0430	1.1025						
E4 Jamb				37.9200	0.0340	1.2893						
R1 Head of roof window				2.5000	0.2400	0.6000						
R2 Sill of roof window				2.5000	0.2400	0.6000						
R3 Jamb of roof window				2.0000	0.2400	0.4800						
R11 Upstands or kerbs of rooflights				18.0000	0.2400	4.3200						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.0085 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	112.2871 (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
	23.6511	23.1846	23.0292	22.2518	22.0963	21.1634	21.1634	21.0079	21.4744	22.4072	22.5627	23.3401 (38)
Heat transfer coeff	135.9382	135.4718	135.3163	134.5389	134.3834	133.4505	133.4505	133.2951	133.7615	134.6944	134.8498	135.6272 (39)
Average = Sum(39)m / 12 =												134.5648
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8230	0.8201	0.8192	0.8145	0.8136	0.8079	0.8079	0.8070	0.8098	0.8154	0.8164	0.8211 (40)
HLP (average)												0.8147
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

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Assumed occupancy															2.9561	(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	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths																
85.1167	83.8526	82.0725	78.7903	76.3326	73.6074	72.1354	73.9030	75.8277	78.7437	82.0936	84.8289	84.8289	84.8289	84.8289	84.8289	(42b)
Hot water usage for other uses																
44.9031	43.2702	41.6374	40.0046	38.3717	36.7389	36.7389	38.3717	40.0046	41.6374	43.2702	44.9031	44.9031	44.9031	44.9031	44.9031	(42c)
Average daily hot water use (litres/day)															119.7376	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
130.0198	127.1228	123.7099	118.7948	114.7043	110.3462	108.8742	112.2747	115.8323	120.3811	125.3638	129.7320	129.7320	129.7320	129.7320	129.7320	(44)
Energy cont	205.9195	181.0212	190.1375	162.6242	154.4140	135.6836	131.6740	139.0196	142.8328	163.3561	178.6037	203.1290	203.1290	203.1290	203.1290	(45)
Energy content (annual)																
Distribution loss (46)m = 0.15 x (45)m																
30.8879	27.1532	28.5206	24.3936	23.1621	20.3525	19.7511	20.8529	21.4249	24.5034	26.7906	30.4693	30.4693	30.4693	30.4693	30.4693	(46)
Water storage loss:																
Store volume															250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):															1.6000	(48)
Temperature factor from Table 2b															0.5400	(49)
Enter (49) or (54) in (55)															0.8640	(55)
Total storage loss																
26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	25.9200	26.7840	25.9200	26.7840	(56)
If cylinder contains dedicated solar storage																
26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	23.2624	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	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month																
255.9659	226.2244	238.7881	204.3026	191.6661	171.5089	168.6934	176.9695	185.8619	212.0067	227.0357	253.1754	253.1754	253.1754	253.1754	253.1754	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	-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															698.2693	(H24)
Heat delivered to space heating															0.0000	(H29)
Solar input															698.2693	(63c)
Solar input	-6.5550	-23.8532	-66.7616	-90.8119	-107.1842	-105.7549	-92.5814	-90.3966	-67.1729	-38.1285	-9.0690	-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	0.0000	0.0000	(63a)
Output from w/h																
249.4109	202.3712	172.0266	113.4906	84.4819	65.7540	76.1120	86.5729	118.6889	173.8782	217.9667	253.1754	253.1754	253.1754	253.1754	253.1754	(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	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																
108.5054	96.3521	102.1412	87.4153	81.1443	73.7750	73.3972	76.5840	81.9152	93.2364	98.1313	107.5775	107.5775	107.5775	107.5775	107.5775	(65)

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

Metabolic gains (Table 5), Watts																
(66)m	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	177.3640	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5																
37.5072	33.3135	27.0924	20.5107	15.3320	12.9439	13.9863	18.1800	24.4011	30.9828	36.1615	38.5496	38.5496	38.5496	38.5496	38.5496	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5																
502.3894	507.6026	494.4654	466.4980	431.1940	398.0133	375.8466	370.6333	383.7705	411.7380	447.0419	480.2226	480.2226	480.2226	480.2226	480.2226	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5																
55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	55.6925	(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	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)																
-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	-118.2426	(71)
Water heating gains (Table 5)																
145.8405	143.3811	137.2866	121.4101	109.0649	102.4653	98.6521	102.9355	113.7711	125.3178	136.2935	144.5934	144.5934	144.5934	144.5934	144.5934	(72)
Total internal gains																
800.5509	799.1110	773.6582	723.2325	670.4047	628.2363	603.2988	606.5625	636.7565	682.8524	734.3107	778.1794	778.1794	778.1794	778.1794	778.1794	(73)

## 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains						
		m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W						
			W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
North		1.9200	14.1962	0.6800	0.7000	0.7700	8.9911	(74)					
East		9.8000	26.5726	0.6800	0.7000	0.7700	85.9016	(76)					
West		18.3800	26.5726	0.6800	0.7000	0.7700	161.1092	(80)					
North		6.0000	36.0000	0.7600	0.7000	1.0000	103.4208	(82)					
Horizontal		2.5000	36.0000	0.7600	0.7000	1.0000	43.0920	(82)					
Solar gains	402.5147	678.8054	1113.3344	1699.4394	1974.9819	2181.0814	1849.5850	1712.1013	1339.0268	815.2357	475.4308	339.3112	(83)
Total gains	1203.0656	1477.9165	1886.9926	2422.6719	2645.3866	2809.3177	2452.8837	2318.6639	1975.7833	1498.0880	1209.7416	1117.4906	(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	38.8834	39.0173	39.0621	39.2878	39.3332	39.6082	39.6082	39.6544	39.5161	39.2424	39.1972	38.9725	38.9725	38.9725	38.9725	38.9725	(86)
alpha	3.5922	3.6012	3.6041	3.6192	3.6222	3.6405	3.6405	3.6436	3.6344	3.6162	3.6131	3.5982	3.5982	3.5982	3.5982	3.5982	(86)
util living area																	
0.9369	0.8891	0.7787	0.6060	0.4598	0.3240	0.2809	0.2908	0.4510	0.7269	0.8933	0.9452	0.9452	0.9452	0.9452	0.9452	0.9452	(86)

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Living	19.9995	20.2211	20.5373	20.7758	20.8704	20.9051	20.9105	20.9101	20.8849	20.7083	20.3279	19.9750
Non living	19.0631	19.3372	19.7158	19.9896	20.0913	20.1298	20.1347	20.1353	20.1114	19.9249	19.4774	19.0348
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	20.4882	20.2211	20.5373	20.7758	20.8704	20.9051	20.9105	20.9101	20.8849	20.7083	20.3279	20.1184 (87)
Th 2	20.2335	20.2359	20.2367	20.2408	20.2416	20.2465	20.2465	20.2473	20.2449	20.2400	20.2392	20.2351 (88)
util rest of house	0.9279	0.8751	0.7557	0.5762	0.4262	0.2896	0.2409	0.2487	0.4058	0.6911	0.8768	0.9371 (89)
MIT 2	19.7669	19.3372	19.7158	19.9896	20.0913	20.1298	20.1347	20.1353	20.1114	19.9249	19.4774	19.2511 (90)
Living area fraction									FLA = Living area / (4) =			0.2815 (91)
MIT	19.9699	19.5860	19.9470	20.2109	20.3105	20.3480	20.3531	20.3534	20.3291	20.1454	19.7168	19.4952 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9699	19.5860	19.9470	20.2109	20.3105	20.3480	20.3531	20.3534	20.3291	20.1454	19.7168	19.4952 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9245	0.8616	0.7464	0.5750	0.4293	0.2943	0.2466	0.2547	0.4109	0.6863	0.8638	0.9278 (94)
Useful gains	1112.2425	1273.3271	1408.3852	1392.9383	1135.7040	826.7337	604.7617	590.5288	811.9306	1028.1812	1044.9860	1036.7911 (95)
Ext temp.	5.6000	5.9000	7.2000	9.0000	11.6000	14.1000	15.8000	15.9000	14.1000	11.3000	8.4000	5.9000 (96)
Heat loss rate W	1953.4176	1854.0607	1724.8768	1508.3012	1170.5508	833.7995	607.6083	593.6177	833.2159	1191.4276	1526.0654	1843.8813 (97)
Space heating kWh	625.8343	390.2529	235.4698	83.0613	25.9261	0.0000	0.0000	0.0000	0.0000	121.4553	346.3772	600.4751 (98a)
Space heating requirement - total per year (kWh/year)												2428.8520
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	625.8343	390.2529	235.4698	83.0613	25.9261	0.0000	0.0000	0.0000	0.0000	121.4553	346.3772	600.4751 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2428.8520
Space heating per m2										(98c) / (4) =		14.7043 (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 %)												364.6798 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	625.8343	390.2529	235.4698	83.0613	25.9261	0.0000	0.0000	0.0000	0.0000	121.4553	346.3772	600.4751 (98)
Space heating efficiency (main heating system 1)	364.6798	364.6798	364.6798	364.6798	364.6798	0.0000	0.0000	0.0000	0.0000	364.6798	364.6798	364.6798 (210)
Space heating fuel (main heating system)	171.6120	107.0125	64.5689	22.7765	7.1093	0.0000	0.0000	0.0000	0.0000	33.3046	94.9812	164.6582 (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	249.4109	202.3712	172.0266	113.4906	84.4819	65.7540	76.1120	86.5729	118.6889	173.8782	217.9667	253.1754 (64)
Efficiency of water heater (217)m	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804	197.9804 (216)
Fuel for water heating, kWh/month	125.9776	102.2178	86.8907	57.3242	42.6718	33.2124	38.4442	43.7280	59.9498	87.8260	110.0951	127.8790 (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	47.2279	42.6574	47.2279	45.7044	47.2279	45.7044	47.2279	47.2279	45.7044	47.2279	45.7044	47.2279 (231)
Lighting	32.8298	26.3373	23.7138	17.3737	13.4200	10.9642	12.2422	15.9128	20.6692	27.1191	30.6309	33.7422 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-118.8898	-142.6967	-189.8170	-198.4285	-196.3029	-181.6828	-175.8273	-174.6411	-165.8642	-153.6280	-121.0255	-105.7732 (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	-79.9238	-137.8231	-274.2449	-437.7666	-537.9583	-592.3155	-506.2886	-475.1264	-356.5042	-205.8503	-101.0894	-65.7603 (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												666.0232 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												197.9804
Water heating fuel used												916.2166 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)												
mechanical ventilation fans (SFP = 0.8360)												476.0701 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												556.0701 (231)
Electricity for lighting (calculated in Appendix L)												264.9553 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-5695.2282 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												

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Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-3291.9630	(238)

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 10a. Fuel costs - using BEDF prices (536)  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	666.0232	25.1600	167.5714 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	916.2166	25.1600	230.5201 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	476.0701	25.1600	119.7792 (249)
Pump for solar water heating	80.0000	25.1600	20.1280 (249)
Energy for lighting	264.9553	25.1600	66.6627 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1924.5768	25.1600	-484.2235
PV Unit electricity exported	-3770.6513	5.8100	-219.0748
Total			-703.2984 (252)
Total energy cost			-98.6368 (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	666.0232	0.1575	104.8801 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	916.2166	0.1461	133.8907 (264)
Space and water heating			238.7708 (265)
Pumps, fans and electric keep-hot	556.0701	0.1387	77.1338 (267)
Energy for lighting	264.9553	0.1443	38.2412 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1924.5768	0.1367	-263.0630
PV Unit electricity exported	-3770.6513	0.1266	-477.4316
Total			-740.4947 (269)
Total CO2, kg/year			-386.3488 (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	666.0232	1.5829	1054.2396 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	916.2166	1.5406	1411.5094 (278)
Space and water heating			2465.7490 (279)
Pumps, fans and electric keep-hot	556.0701	1.5128	841.2228 (281)
Energy for lighting	264.9553	1.5338	406.3973 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1924.5768	1.5053	-2897.0091
PV Unit electricity exported	-3770.6513	0.4648	-1752.7623
Total			-4649.7714 (283)
Total Primary energy kWh/year			-936.4023 (286)