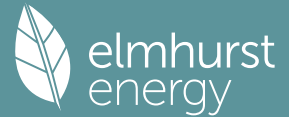


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Property Reference	Plot 1		Issued on Date	26/02/2024	
Assessment Reference	Plot 1	Prop Type Ref			
Property	Plot 1, Higher Churchtown Farm, Tresmeer, Launceston, Cornwall, PL15 8QT				
SAP Rating	98 A	DER	0.33	TER	7.96
Environmental	100 A	% DER < TER		95.85	
CO <sub>2</sub> Emissions (t/year)	0	DFEE	37.77	TFEE	45.03
Compliance Check	See BREL	% DFEE < TFEE		16.13	
% DPER < TPER	89.55	DPER	4.48	TPER	42.83
Assessor Details	Mr. Benjamin Marsh			Assessor ID	E695-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1042.1860 (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												3.0000 (17)	
Infiltration rate												0.1500 (18)	
Number of sides sheltered												0 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =											1.0000 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =												77.4000 (23c)	
Effective ac	0.3042	0.3005	0.2967	0.2780	0.2742	0.2555	0.2555	0.2518	0.2630	0.2742	0.2817	0.2893	(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
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)
Solid Door			2.0200	1.2000	2.4240		(26)
North West			2.8200	1.1450	3.2290		(27a)
South East			8.1500	1.1450	9.3321		(27a)
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000	22262.9000 (28a)
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000	66650.1000 (29a)
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000	2344.3200 (30)
Flat roof	10.4400		10.4400	0.0900	0.9396	9.0000	93.9600 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			963.7000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	261.2465			(33)
Internal Wall 1			548.9200			9.0000	4940.2800 (32c)
Internal Ceiling 1			132.0600			9.0000	1188.5400 (32e)
Internal Ceiling 2			79.4900			9.0000	715.4100 (32e)

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Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 98195.5100 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 237.2216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	57.2000	0.0190	1.0868
E3 Sill	44.2000	0.0160	0.7072
E4 Jamb	137.9000	0.0180	2.4822
E5 Ground floor (normal)	87.1000	0.0540	4.7034
E6 Intermediate floor within a dwelling	107.0000	0.0080	0.8560
E11 Eaves (insulation at rafter level)	69.0000	0.0520	3.5880
E13 Gable (insulation at rafter level)	20.6500	0.0560	1.1564
E14 Flat roof	5.8000	0.0460	0.2668
E16 Corner (normal)	41.1000	0.0400	1.6440
E17 Corner (inverted - internal area greater than external area)	12.1000	-0.0680	-0.8228

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.6680 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 276.9145 (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	104.6381	103.3484	102.0587	95.6101	94.3204	87.8719	87.8719	86.5822	90.4513	94.3204	96.8998	99.4793 (38)
Average = Sum(39)m / 12 =	381.5525	380.2628	378.9731	372.5246	371.2349	364.7864	364.7864	363.4967	367.3658	371.2349	373.8143	376.3937 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9218	0.9186	0.9155	0.8999	0.8968	0.8813	0.8813	0.8781	0.8875	0.8968	0.9031	0.9093 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 3.2801 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	79.2156	78.0252	76.2904	72.9714	70.5219	67.7904	66.2378	67.9594	69.8466	72.7794	76.1698	78.9121 (42a)
Hot water usage for baths	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730 (42b)
Hot water usage for other uses	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210 (42c)
Average daily hot water use (litres/day)	381.5525	380.2628	378.9731	372.5246	371.2349	364.7864	364.7864	363.4967	367.3658	371.2349	373.8143	376.3937 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061 (44)
Energy conte	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098 (45)
Energy content (annual)	381.5525	380.2628	378.9731	372.5246	371.2349	364.7864	364.7864	363.4967	367.3658	371.2349	373.8143	376.3937 (45)
Distribution loss (46)m = 0.15 x (45)m	57.2329	57.0394	56.8459	55.8787	55.6852	54.7180	54.7180	55.7508	56.7836	57.8164	58.8492	60.8816 (46)
Water storage loss:												
Store volume												188.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1910 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6431 (55)
Total storage loss												0.6431 (55)
If cylinder contains dedicated solar storage	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (56)
Primary loss	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (64)
Total per year (kWh/year)												2976.3523 (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	119.6714	106.1066	113.2448	100.6195	98.2945	89.3792	88.7129	91.7253	92.1843	101.8436	107.1593	118.4860 (65)

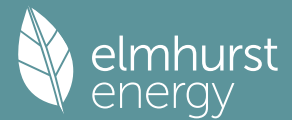
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	274.9465	304.4051	274.9465	284.1114	274.9465	284.1114	274.9465	274.9465	284.1114	274.9465	284.1114	274.9465 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	545.1122	550.7688	536.5145	506.1686	467.8625	431.8601	407.8083	402.1518	416.4061	446.7519	485.0581	521.0604 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	160.8487	157.8967	152.2107	139.7493	132.1162	124.1378	119.2378	123.2867	128.0337	136.8866	148.8323	159.2554 (72)
Total internal gains	1053.1082	1085.2714	1035.8725	1002.2301	947.1260	912.3101	874.1934	872.5857	900.7520	930.7858	990.2026	1027.4632 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
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Northeast		37.2900		11.2829		0.6300		0.8000		0.7700		146.9530 (75)
Southeast		39.8700		36.7938		0.6300		0.8000		0.7700		512.3716 (77)
Southwest		30.5400		36.7938		0.6300		0.8000		0.7700		392.4712 (79)
Northwest		18.9100		11.2829		0.6300		0.8000		0.7700		74.5208 (81)
Southeast		8.1500		39.9751		0.6300		0.8000		1.0000		147.7817 (82)
Northwest		2.8200		16.3666		0.6300		0.8000		1.0000		20.9353 (82)

Solar gains	1295.0337	2306.8413	3415.0079	4649.6444	5578.6949	5698.4537	5427.5089	4711.8769	3840.0515	2620.2054	1569.7576	1096.1166 (83)
Total gains	2348.1419	3392.1127	4450.8803	5651.8745	6525.8209	6610.7639	6301.7023	5584.4626	4740.8035	3550.9912	2559.9602	2123.5798 (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	71.4883	71.7307	71.9748	73.2208	73.4751	74.7740	74.7740	75.0393	74.2490	73.4751	72.9681	72.4681
alpha	5.7659	5.7820	5.7983	5.8814	5.8983	5.9849	5.9849	6.0026	5.9499	5.8983	5.8645	5.8312
util living area	0.9980	0.9851	0.9265	0.7434	0.5231	0.3527	0.2546	0.2993	0.5286	0.8883	0.9920	0.9989 (86)
Living	19.8636	20.2151	20.6126	20.9134	20.9891	20.9992	20.9999	20.9998	20.9918	20.7997	20.2478	19.8116
Non living	18.8078	19.2561	19.7451	20.0892	20.1622	20.1830	20.1834	20.1860	20.1732	19.9826	19.3104	18.7492
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	16	0	0	0	0	0	0	0	0	0	0	0
16 / 9	15	28	20	0	0	0	0	0	0	0	0	31
MIT	20.6886	20.5554	20.7210	20.9134	20.9891	20.9992	20.9999	20.9998	20.9918	20.7997	20.2478	20.3269 (87)
Th 2	20.1490	20.1517	20.1543	20.1675	20.1702	20.1835	20.1835	20.1861	20.1782	20.1702	20.1649	20.1596 (88)
util rest of house	0.9974	0.9808	0.9089	0.7045	0.4785	0.3079	0.2074	0.2464	0.4682	0.8553	0.9891	0.9985 (89)
MIT 2	19.8626	19.7564	19.8926	20.0892	20.1622	20.1830	20.1834	20.1860	20.1732	19.9826	19.3104	19.5371 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	19.9504	19.8413	19.9806	20.1768	20.2501	20.2698	20.2702	20.2725	20.2603	20.0694	19.4101	19.6210 (91)
Temperature adjustment												0.0000
adjusted MIT	19.9504	19.8413	19.9806	20.1768	20.2501	20.2698	20.2702	20.2725	20.2603	20.0694	19.4101	19.6210 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9972	0.9789	0.9048	0.7050	0.4828	0.3127	0.2124	0.2520	0.4743	0.8507	0.9855	0.9982 (94)
Useful gains	2341.5758	3320.6813	4027.2106	3984.4228	3150.6894	2066.8970	1338.7469	1407.3836	2248.4582	3020.8035	2522.8463	2119.7490 (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	5971.4482	5681.6306	5108.7949	4200.8797	3174.0771	2068.2538	1338.8461	1407.6527	2263.0667	3515.3773	4601.6788	5804.3846 (97)
Space heating kWh	2700.6251	1586.5580	804.6987	155.8490	17.4005	0.0000	0.0000	0.0000	0.0000	367.9630	1496.7595	2741.3689 (98a)
Space heating requirement - total per year (kWh/year)												9871.2225
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	2700.6251	1586.5580	804.6987	155.8490	17.4005	0.0000	0.0000	0.0000	0.0000	367.9630	1496.7595	2741.3689 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9871.2225
Space heating per m2												(98c) / (4) = 23.8470 (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 %) 451.4428 (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	2700.6251	1586.5580	804.6987	155.8490	17.4005	0.0000	0.0000	0.0000	0.0000	367.9630	1496.7595	2741.3689 (98)
Space heating efficiency (main heating system 1)	451.4428	451.4428	451.4428	451.4428	451.4428	0.0000	0.0000	0.0000	0.0000	451.4428	451.4428	451.4428 (210)
Space heating fuel (main heating system)	598.2209	351.4416	178.2504	34.5224	3.8544	0.0000	0.0000	0.0000	0.0000	81.5082	331.5502	607.2461 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (64)
Efficiency of water heater (217)m	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362 (216)
Fuel for water heating, kWh/month	157.7623	139.3489	147.5700	128.5803	123.8598	110.7539	108.6640	113.4414	115.2025	129.4885	138.9520	155.8824 (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	163.2773	147.4762	163.2773	158.0102	163.2773	158.0102	163.2773	163.2773	158.0102	163.2773	158.0102	163.2773 (231)
Lighting	71.4608	57.3285	51.6179	37.8175	29.2113	23.8659	26.6476	34.6375	44.9907	59.0302	66.6745	73.4469 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-190.4356	-296.4426	-453.7244	-532.8724	-597.7023	-567.4477	-563.2266	-522.5585	-450.5864	-354.1504	-219.8362	-161.6248 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-5.4364	-19.2848	-57.5971	-119.2643	-182.9935	-190.8081	-188.8661	-150.4704	-99.7968	-41.9832	-10.2260	-3.8601 (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)

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Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)	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											2186.5943	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											189.6362	
Water heating fuel used											1569.5061	(219)
Space cooling fuel											0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5120) mechanical ventilation fans (SFP = 1.5120)											1922.4580	(230a)
Total electricity for the above, kWh/year											1922.4580	(231)
Electricity for lighting (calculated in Appendix L)											576.7293	(232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											-5981.1947	(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											274.0930	(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	2186.5943	0.1585	346.5888 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1569.5061	0.1411	221.4391 (264)
Space and water heating			568.0279 (265)
Pumps, fans and electric keep-hot	1922.4580	0.1387	266.6686 (267)
Energy for lighting	576.7293	0.1443	83.2399 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-4910.6080	0.1333	-654.8037
PV Unit electricity exported	-1070.5867	0.1191	-127.5178
Total			-782.3214 (269)
Total CO2, kg/year			135.6150 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.3300 (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	2186.5943	1.5867	3469.4102 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1569.5061	1.5217	2388.3223 (278)
Space and water heating			5857.7326 (279)
Pumps, fans and electric keep-hot	1922.4580	1.5128	2908.2944 (281)
Energy for lighting	576.7293	1.5338	884.6067 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-4910.6080	1.4928	-7330.3387
PV Unit electricity exported	-1070.5867	0.4369	-467.7780
Total			-7798.1167 (283)
Total Primary energy kWh/year			1852.5169 (286)
Dwelling Primary energy Rate (DPER)			4.4800 (287)

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

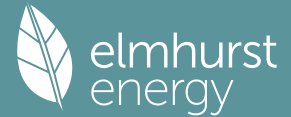
### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1042.1860 (5)

### 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
	Air changes per hour

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0384 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.2884 (18)
Number of sides sheltered			0 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2884 (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													
	0.3677	0.3605	0.3533	0.3172	0.3100	0.2740	0.2740	0.2668	0.2884	0.3100	0.3244	0.3388	(22b)
Effective ac	0.5676	0.5650	0.5624	0.5503	0.5481	0.5375	0.5375	0.5356	0.5416	0.5481	0.5526	0.5574	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0200	1.0000	2.0200			(26)
TER Opening Type (Uw = 1.20)			93.3700	1.1450	106.9122			(27)
North West			2.0800	1.8519	3.8519			(27a)
South East			6.0100	1.8519	11.1296			(27a)
Heatloss Floor 1			202.3900	0.1300	26.3107			(28a)
Cavity Wall	479.4200	95.3900	384.0300	0.1800	69.1254			(29a)
Warm Roof	271.4500	8.0900	263.3600	0.1100	28.9696			(30)
Flat roof	10.4400		10.4400	0.1100	1.1484			(30)
Total net area of external elements Aum(A, m2)			963.7000					(31)
Fabric heat loss, W/K = Sum (A x U)					249.4678			(32)
								(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 237.2216 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	57.2000	0.0500	2.8600
E3 Sill	44.2000	0.0500	2.2100
E4 Jamb	137.9000	0.0500	6.8950
E5 Ground floor (normal)	87.1000	0.1600	13.9360
E6 Intermediate floor within a dwelling	107.0000	0.0000	0.0000
E11 Eaves (insulation at rafter level)	69.0000	0.0400	2.7600
E13 Gable (insulation at rafter level)	20.6500	0.0800	1.6520
E14 Flat roof	5.8000	0.0800	0.4640
E16 Corner (normal)	41.1000	0.0900	3.6990
E17 Corner (inverted - internal area greater than external area)	12.1000	-0.0900	-1.0890

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 33.3870 (36)

#### Point Thermal bridges

Total fabric heat loss (33) + (36) + (36a) = 282.8548 (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	
	195.2085	194.3058	193.4209	189.2647	188.4871	184.8672	184.8672	184.1969	186.2615	188.4871	190.0602	191.7048	(38)
Heat transfer coeff	478.0633	477.1606	476.2757	472.1195	471.3419	467.7220	467.7220	467.0517	469.1163	471.3419	472.9150	474.5596	(39)
Average = Sum(39)m / 12 =													472.1158

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1.1549	1.1527	1.1506	1.1406	1.1387	1.1299	1.1299	1.1283	1.1333	1.1387	1.1425	1.1464	(40)
HLP (average)													1.1405
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 3.2801 (42)

Hot water usage for mixer showers 78.9121 (42a)

Hot water usage for baths 34.0730 (42b)

Hot water usage for other uses 48.2210 (42c)

Average daily hot water use (litres/day) 148.5696 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061	(44)
Energy conte	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098	(45)
Energy content (annual)													2467.7102
Distribution loss (46)m = 0.15 x (45)m													
	38.3962	33.7855	35.4970	30.3043	28.7525	25.2335	24.4300	25.7889	26.4989	30.3536	33.2546	37.8615	(46)

Water storage loss:

Store volume 188.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.5926 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8600 (55)

Total storage loss 188.0000 (47)

26.6608 24.0807 26.6608 25.8007 26.6608 25.8007 26.6608 26.6608 25.8007 26.6608 25.8007 26.6608 26.6608 (56)

If cylinder contains dedicated solar storage 26.6608 (57)

Primary loss 23.2624 (59)

Combi loss 0.0000 (61)

Total heat required for water heating calculated for each month

305.8979 270.3288 286.5697 250.3414 241.6064 216.5361 212.7896 221.8495 224.9723 252.2806 270.0099 302.3329 (62)

WWHRS -35.5434 (63a)

PV diverter -0.0000 (63b)

Solar input 0.0000 (63c)

FGHRS 0.0000 (63d)

Output from w/h 266.7895 (64)

269.6838 238.3008 253.0318 222.5707 215.7251 194.3892 192.0305 199.7742 202.0583 225.2675 239.4075 2719.0291 (64)

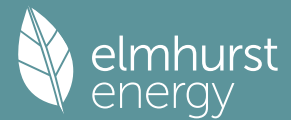
12Total per year (kWh/year) 2719 (64)

Electric shower(s) 0.0000 (64a)

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

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

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Heat gains from water heating, kWh/month  
 125.0501 110.9648 118.6235 105.8247 103.6732 94.5844 94.0916 97.1040 97.3895 107.2224 112.3645 123.8648 (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	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	274.9465	304.4051	274.9465	284.1114	274.9465	284.1114	274.9465	274.9465	284.1114	274.9465	284.1114	274.9465 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	545.1122	550.7688	536.5145	506.1686	467.8625	431.8601	407.8083	402.1518	416.4061	446.7519	485.0581	521.0604 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	168.0781	165.1262	159.4402	146.9788	139.3457	131.3673	126.4672	130.5162	135.2632	144.1161	156.0618	166.4849 (72)
Total internal gains	1063.3377	1095.5008	1046.1019	1012.4596	957.3555	919.5396	881.4229	879.8152	907.9815	941.0153	1000.4321	1037.6927 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	27.5000	11.2829	0.6300	0.7000	0.7700	94.8259 (75)						
Southeast	29.4000	36.7938	0.6300	0.7000	0.7700	330.5934 (77)						
Southwest	22.5200	36.7938	0.6300	0.7000	0.7700	253.2300 (79)						
Northwest	13.9500	11.2829	0.6300	0.7000	0.7700	48.1026 (81)						
Southeast	6.0100	39.9751	0.6300	0.7000	1.0000	95.3554 (82)						
Northwest	2.0800	16.3666	0.6300	0.7000	1.0000	13.5115 (82)						
Solar gains	835.6188	1488.4949	2203.5640	3000.2583	3599.7720	3677.0610	3502.2226	3040.4259	2477.8386	1690.6997	1012.8856	707.2669 (83)
Total gains	1898.9565	2583.9958	3249.6659	4012.7179	4557.1276	4596.6006	4383.6455	3920.2412	3385.8201	2631.7150	2013.3177	1744.9595 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	57.0563	57.1643	57.2705	57.7746	57.8699	58.3178	58.3178	58.4015	58.1445	57.8699	57.6774	57.4776
alpha	4.8038	4.8110	4.8180	4.8516	4.8580	4.8879	4.8879	4.8934	4.8763	4.8580	4.8452	4.8318
util living area	0.9992	0.9965	0.9858	0.9386	0.8128	0.6209	0.4632	0.5346	0.8106	0.9768	0.9978	0.9995 (86)
MIT	19.3590	19.6224	20.0009	20.4738	20.8162	20.9622	20.9926	20.9857	20.8667	20.3695	19.7663	19.3180 (87)
Th 2	19.9562	19.9580	19.9597	19.9679	19.9694	19.9765	19.9765	19.9778	19.9737	19.9694	19.9663	19.9631 (88)
util rest of house	0.9990	0.9953	0.9810	0.9181	0.7587	0.5337	0.3587	0.4225	0.7348	0.9657	0.9968	0.9993 (89)
MIT 2	18.0231	18.3613	18.8438	19.4331	19.8166	19.9551	19.9741	19.9726	19.8808	19.3187	18.5522	17.9751 (90)
Living area fraction												0.1063 (91)
MIT	18.1651	18.4953	18.9668	19.5437	19.9229	20.0621	20.0823	20.0803	19.9856	19.4304	18.6812	18.1179 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1651	18.4953	18.9668	19.5437	19.9229	20.0621	20.0823	20.0803	19.9856	19.4304	18.6812	18.1179 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9982	0.9928	0.9744	0.9076	0.7560	0.5414	0.3697	0.4341	0.7358	0.9574	0.9950	0.9988 (94)
Useful gains	1895.6122	2565.3541	3166.5599	3641.9235	3445.1800	2488.3909	1620.6408	1701.6777	2491.2354	2519.6963	2003.3102	1742.8915 (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	6628.3778	6487.1614	5937.6433	5025.1179	3875.7950	2554.7663	1628.7642	1718.8901	2761.0164	4162.1475	5476.9442	6604.8561 (97)
Space heating kWh	3521.1776	2635.4545	2061.6860	995.8999	320.3776	0.0000	0.0000	0.0000	0.0000	1221.9837	2501.0165	3617.3017 (98a)
Space heating requirement - total per year (kWh/year)												16874.8975
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	3521.1776	2635.4545	2061.6860	995.8999	320.3776	0.0000	0.0000	0.0000	0.0000	1221.9837	2501.0165	3617.3017 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16874.8975
Space heating per m2												(98c) / (4) = 40.7665 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from main system(s)												0.0000 (201)
Efficiency of main space heating system 1 (in %)												1.0000 (202)
Efficiency of main space heating system 2 (in %)												92.3000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (207)
												0.0000 (208)
Space heating requirement	3521.1776	2635.4545	2061.6860	995.8999	320.3776	0.0000	0.0000	0.0000	0.0000	1221.9837	2501.0165	3617.3017 (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)	3814.9270	2855.3136	2233.6794	1078.9815	347.1046	0.0000	0.0000	0.0000	0.0000	1323.9260	2709.6603	3919.0701 (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)

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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	269.6838	238.3008	253.0318	222.5707	215.7251	194.3892	192.0305	199.7742	202.0583	225.2675	239.4075	266.7895	(64)	
Efficiency of water heater (217)m	88.0932	87.9772	87.7185	87.0075	84.9450	79.8000	79.8000	79.8000	79.8000	87.2680	87.9336	88.1174	(217)	
Fuel for water heating, kWh/month	306.1347	270.8665	288.4587	255.8062	253.9587	243.5955	240.6398	250.3436	253.2059	258.1329	272.2594	302.7660	(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	57.1285	45.8306	41.2653	30.2328	23.3527	19.0793	21.3031	27.6905	35.9673	47.1910	53.3021	58.7162	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-152.0506	-197.8776	-262.5902	-271.5085	-273.7204	-248.3390	-244.5068	-239.2361	-228.5565	-213.3010	-160.7955	-133.4008	(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	-144.2882	-294.1416	-568.5022	-831.9278	-1090.1361	-1078.7995	-1066.7553	-912.7234	-681.5072	-413.8401	-190.2209	-114.9075	(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												18282.6626	(211)	
Space heating fuel - main system 2												0.0000	(213)	
Space heating fuel - secondary												0.0000	(215)	
Efficiency of water heater												79.8000	(217)	
Water heating fuel used												3196.1680	(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)													461.0594	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-10003.6328	(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													12022.2571	(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	18282.6626	0.2100	3839.3591 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3196.1680	0.2100	671.1953 (264)
Space and water heating			4510.5544 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	461.0594	0.1443	66.5451 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2625.8830	0.1364	-358.2304
PV Unit electricity exported	-7377.7498	0.1267	-934.5151
Total			-1292.7456 (269)
Total CO2, kg/year			3296.2832 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.9600 (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	18282.6626	1.1300	20659.4087 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3196.1680	1.1300	3611.6699 (278)
Space and water heating			24271.0786 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	461.0594	1.5338	707.1883 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2625.8830	1.5043	-3950.1048
PV Unit electricity exported	-7377.7498	0.4650	-3430.5537
Total			-7380.6585 (283)
Total Primary energy kWh/year			17727.7091 (286)
Target Primary Energy Rate (TPER)			42.8300 (287)

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

### 1. Overall dwelling characteristics

# Full SAP Calculation Printout



	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1042.1860 (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) =	0.0384 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50			3.0000 (17)
Infiltration rate			0.1884 (18)
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.1884 (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
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	0.2402	0.2355	0.2308	0.2072	0.2025	0.1790	0.1790	0.1743	0.1884	0.2025	0.2119	0.2213
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000
Effective ac	0.5288	0.5277	0.5266	0.5215	0.5205	0.5160	0.5160	0.5152	0.5177	0.5205	0.5225	0.5245

## 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
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)
Solid Door			2.0200	1.2000	2.4240		(26)
North West			2.8200	1.1450	3.2290		(27a)
South East			8.1500	1.1450	9.3321		(27a)
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000	22262.9000 (28a)
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000	66650.1000 (29a)
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000	2344.3200 (30)
Flat roof	10.4400		10.4400	0.0900	0.9396	9.0000	93.9600 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			963.7000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	261.2465	(33)
Internal Wall 1			548.9200			9.0000	4940.2800 (32c)
Internal Ceiling 1			132.0600			9.0000	1188.5400 (32e)
Internal Ceiling 2			79.4900			9.0000	715.4100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 98195.5100 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 237.2216 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	57.2000	0.0190	1.0868
E3 Sill	44.2000	0.0160	0.7072
E4 Jamb	137.9000	0.0180	2.4822
E5 Ground floor (normal)	87.1000	0.0540	4.7034
E6 Intermediate floor within a dwelling	107.0000	0.0080	0.8560
E11 Eaves (insulation at rafter level)	69.0000	0.0520	3.5880
E13 Gable (insulation at rafter level)	20.6500	0.0560	1.1564
E14 Flat roof	5.8000	0.0460	0.2668
E16 Corner (normal)	41.1000	0.0400	1.6440
E17 Corner (inverted - internal area greater than external area)	12.1000	-0.0680	-0.8228

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.6680 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 276.9145 (37)

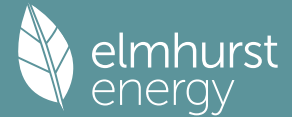
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	181.8810	181.4957	181.1181	179.3446	179.0128	177.4681	177.4681	177.1821	178.0631	179.0128	179.6841	180.3859
Heat transfer coeff	458.7954	458.4102	458.0326	456.2591	455.9273	454.3826	454.3826	454.0965	454.9776	455.9273	456.5985	457.3003
Average = Sum(39)m / 12 =												456.2575
HLP	1.1084	1.1074	1.1065	1.1022	1.1014	1.0977	1.0977	1.0970	1.0991	1.1014	1.1031	1.1048
HLP (average)												1.1022
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												3.2801
Hot water usage for mixer showers												0.0000
Hot water usage for baths	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730
Hot water usage for other uses												



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Average daily hot water use (litres/day)	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210 (42c)
												75.5354 (43)
Daily hot water use	82.4095	80.1483	77.6798	74.6079	71.8673	69.0192	68.4279	70.8914	73.4180	76.3428	79.4418	82.2940 (44)
Energy content (annual)	130.5166	114.1301	119.3910	102.1346	96.7472	84.8671	82.7576	87.7784	90.5317	103.5964	113.1794	128.8525 (45)
Energy content (annual)												1254.4825
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	110.9391	97.0106	101.4823	86.8144	82.2351	72.1371	70.3440	74.6116	76.9520	88.0569	96.2024	109.5246 (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	110.9391	97.0106	101.4823	86.8144	82.2351	72.1371	70.3440	74.6116	76.9520	88.0569	96.2024	109.5246 (64)
												1066.3101 (64)
12Total per year (kWh/year)												1066 (64)
Electric shower(s)	63.4385	56.5242	61.7223	58.9008	60.0061	57.2400	59.1480	60.0061	58.9008	61.7223	60.5617	63.4385 (64a)
												721.6094 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												721.6094 (64a)
Heat gains from water heating, kWh/month	43.5944	38.3837	40.8012	36.4288	35.5603	32.3443	32.3730	33.6544	33.9632	37.4448	39.1910	43.2408 (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	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	274.9465	304.4051	274.9465	284.1114	274.9465	284.1114	274.9465	274.9465	284.1114	274.9465	284.1114	274.9465 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	545.1122	550.7688	536.5145	506.1686	467.8625	431.8601	407.8083	402.1518	416.4061	446.7519	485.0581	521.0604 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	58.5946	57.1186	54.8403	50.5956	47.7961	44.9226	43.5121	45.2345	47.1711	50.3290	54.4320	58.1193 (72)
Total internal gains	950.8542	984.4933	938.5020	913.0764	862.8059	833.0949	798.4677	794.5335	819.8894	844.2283	895.8023	926.3271 (73)

## 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast		37.2900	11.2829	0.6300	0.8000	0.7700	146.9530 (75)					
Southeast		39.8700	36.7938	0.6300	0.8000	0.7700	512.3716 (77)					
Southwest		30.5400	36.7938	0.6300	0.8000	0.7700	392.4712 (79)					
Northwest		18.9100	11.2829	0.6300	0.8000	0.7700	74.5208 (81)					
Southeast		8.1500	39.9751	0.6300	0.8000	1.0000	147.7817 (82)					
Northwest		2.8200	16.3666	0.6300	0.8000	1.0000	20.9353 (82)					
Solar gains	1295.0337	2306.8413	3415.0079	4649.6444	5578.6949	5698.4537	5427.5089	4711.8769	3840.0515	2620.2054	1569.7576	1096.1166 (83)
Total gains	2245.8878	3291.3346	4353.5099	5562.7207	6441.5008	6531.5486	6225.9766	5506.4104	4659.9409	3464.4336	2465.5598	2022.4437 (84)

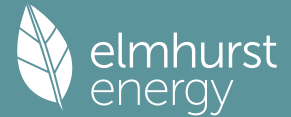
## 7. Mean internal temperature (heating season)

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)												
tau	59.4525	59.5025	59.5515	59.7830	59.8265	60.0299	60.0299	60.0677	59.9514	59.8265	59.7385	59.6469
alpha	4.9635	4.9668	4.9701	4.9855	4.9884	5.0020	5.0020	5.0045	4.9968	4.9884	4.9826	4.9765
util living area	0.9984	0.9899	0.9541	0.8298	0.6278	0.4409	0.3204	0.3775	0.6400	0.9336	0.9945	0.9990 (86)
MIT	19.5258	19.8784	20.3230	20.7535	20.9466	20.9923	20.9987	20.9972	20.9572	20.5894	19.9395	19.4587 (87)
Th 2	19.9940	19.9948	19.9955	19.9990	19.9997	20.0027	20.0027	20.0033	20.0015	19.9997	19.9983	19.9970 (88)
util rest of house	0.9979	0.9868	0.9409	0.7915	0.5697	0.3741	0.2482	0.2967	0.5601	0.9079	0.9924	0.9987 (89)
MIT 2	18.6450	18.9958	19.4281	19.8190	19.9684	19.9996	20.0024	20.0026	19.9811	19.6891	19.0609	18.5803 (90)
Living area fraction									fLA = Living area / (4) =			0.1063 (91)
MIT	18.7386	19.0896	19.5233	19.9183	20.0724	20.1051	20.1083	20.1083	20.0848	19.7848	19.1543	18.6737 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7386	19.0896	19.5233	19.9183	20.0724	20.1051	20.1083	20.1083	20.0848	19.7848	19.1543	18.6737 (93)

## 8. Space heating requirement

Utilisation	0.9969	0.9829	0.9334	0.7881	0.5740	0.3810	0.2558	0.3052	0.5671	0.9012	0.9898	0.9981 (94)
Useful gains	2238.9597	3235.2072	4063.3965	4384.2235	3697.6649	2488.6870	1592.8164	1680.8057	2642.5086	3122.0339	2440.4564	2018.5936 (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	6624.3693	6504.6523	5965.0780	5027.2184	3817.2130	2501.4186	1594.1183	1683.9181	2722.9570	4187.6076	5503.9770	6618.8336 (97)
Space heating kWh												

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Space heating requirement - total per year (kWh/year)	3262.7447	2197.0671	1414.8510	462.9563	88.9438	0.0000	0.0000	0.0000	0.0000	792.7868	2205.7348	3422.5786	(98a)
Solar heating kWh												13847.6632	
Solar heating contribution - total per year (kWh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating kWh	3262.7447	2197.0671	1414.8510	462.9563	88.9438	0.0000	0.0000	0.0000	0.0000	792.7868	2205.7348	3422.5786	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13847.6632	
Space heating per m2												(98c) / (4) =	33.4533 (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													
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	4271.1963	3362.4311	3451.1336	0.0000	0.0000	0.0000	0.0000	(100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9711	0.9866	0.9755	0.0000	0.0000	0.0000	0.0000	(101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	4147.9469	3317.3688	3366.4902	0.0000	0.0000	0.0000	0.0000	(102)
Space cooling kWh						7348.8460	7004.0994	6188.7959	0.0000	0.0000	0.0000	0.0000	(103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	2304.6474	2742.9276	2099.7954	0.0000	0.0000	0.0000	0.0000	(104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	576.1618	685.7319	524.9489	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement													1786.8426 (107)
Energy for space heating													33.4533 (99)
Energy for space cooling													4.3167 (108)
Total													37.7700 (109)
Fabric Energy Efficiency (DFEE)													37.8 (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	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)	
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)	
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1042.1860 (5)

### 2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000 (6a)	
Number of open flues	0 * 20 =	0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)	
Number of blocked chimneys	0 * 20 =	0.0000 (6f)	
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)	
Number of passive vents	0 * 10 =	0.0000 (7b)	
Number of flueless gas fires	0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour	40.0000 / (5) =	0.0384 (8)
Pressure test	Yes		
Pressure Test Method	Blower Door		
Measured/design AP50	5.0000	(17)	
Infiltration rate	0.2884	(18)	
Number of sides sheltered	0	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2884	(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	0.3677	0.3605	0.3533	0.3172	0.3100	0.2740	0.2740	0.2668	0.2884	0.3100	0.3244	0.3388	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													(23c)
Effective ac	0.5676	0.5650	0.5624	0.5503	0.5481	0.5375	0.5375	0.5356	0.5416	0.5481	0.5526	0.5574	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			2.0200	1.0000	2.0200		(26)
TER Opening Type (Uw = 1.20)			93.3700	1.1450	106.9122		(27)
North West			2.0800	1.8519	3.8519		(27a)
South East			6.0100	1.8519	11.1296		(27a)

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Heatloss Floor 1			202.3900	0.1300	26.3107	(28a)
Cavity Wall	479.4200	95.3900	384.0300	0.1800	69.1254	(29a)
Warm Roof	271.4500	8.0900	263.3600	0.1100	28.9696	(30)
Flat roof	10.4400		10.4400	0.1100	1.1484	(30)
Total net area of external elements Aum(A, m2)			963.7000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	249.4678		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 237.2216 (35)

List of Thermal Bridges				Length	Psi-value	Total
K1 Element						
E2 Other lintels (including other steel lintels)			57.2000	0.0500	2.8600	
E3 Sill			44.2000	0.0500	2.2100	
E4 Jamb			137.9000	0.0500	6.8950	
E5 Ground floor (normal)			87.1000	0.1600	13.9360	
E6 Intermediate floor within a dwelling			107.0000	0.0000	0.0000	
E11 Eaves (insulation at rafter level)			69.0000	0.0400	2.7600	
E13 Gable (insulation at rafter level)			20.6500	0.0800	1.6520	
E14 Flat roof			5.8000	0.0800	0.4640	
E16 Corner (normal)			41.1000	0.0900	3.6990	
E17 Corner (inverted - internal area greater than external area)			12.1000	-0.0900	-1.0890	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 33.3870 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 282.8548 (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	195.2085	194.3058	193.4209	189.2647	188.4871	184.8672	184.8672	184.1969	186.2615	188.4871	190.0602	191.7048
Average = Sum(39)m / 12 =	478.0633	477.1606	476.2757	472.1195	471.3419	467.7220	467.7220	467.0517	469.1163	471.3419	472.9150	474.5596
	472.1158 (39)											

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1549	1.1527	1.1506	1.1406	1.1387	1.1299	1.1299	1.1283	1.1333	1.1387	1.1425	1.1464
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
	1.1405 (40)											

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

Assumed occupancy													3.2801	(42)	
Hot water usage for mixer showers													0.0000	(42a)	
Hot water usage for baths	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730	34.0730	(42b)	
Hot water usage for other uses	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210	48.2210	(42c)	
Average daily hot water use (litres/day)													75.5354	(43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Energy conte	82.4095	80.1483	77.6798	74.6079	71.8673	69.0192	68.4279	70.8914	73.4180	76.3428	79.4418	82.2940	82.2940	(44)	
Energy content (annual)	130.5166	114.1301	119.3910	102.1346	96.7472	84.8671	82.7576	87.7784	90.5317	103.5964	113.1794	128.8525	128.8525	(45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m =	1254.4825	
Water storage loss:													0.0000	(46)	
Total storage loss													0.0000	(56)	
If cylinder contains dedicated solar storage													0.0000	(57)	
Primary loss													0.0000	(59)	
Combi loss													0.0000	(61)	
Total heat required for water heating calculated for each month	110.9391	97.0106	101.4823	86.8144	82.2351	72.1371	70.3440	74.6116	76.9520	88.0569	96.2024	109.5246	109.5246	(62)	
WWHRs													0.0000	(63a)	
PV diverter													0.0000	(63b)	
Solar input													0.0000	(63c)	
FGHRs													0.0000	(63d)	
Output from w/h	110.9391	97.0106	101.4823	86.8144	82.2351	72.1371	70.3440	74.6116	76.9520	88.0569	96.2024	109.5246	109.5246	(64)	
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m =	1066.3101	(64)
Electric shower(s)													1066	(64)	
Heat gains from water heating, kWh/month	43.5944	38.3837	40.8012	36.4288	35.5603	32.3443	32.3730	33.6544	33.9632	37.4448	39.1910	43.2408	43.2408	(65)	

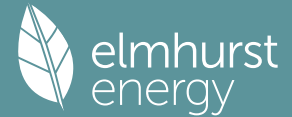
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026	164.0026
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	274.9465	304.4051	274.9465	284.1114	274.9465	284.1114	274.9465	274.9465	284.1114	274.9465	284.1114	274.9465
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	545.1122	550.7688	536.5145	506.1686	467.8625	431.8601	407.8083	402.1518	416.4061	446.7519	485.0581	521.0604
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003	39.4003
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
Losses e.g. evaporation (negative values) (Table 5)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021
Water heating gains (Table 5)	58.5946	57.1186	54.8403	50.5956	47.7961	44.9226	43.5121	45.2345	47.1711	50.3290	54.4320	58.1193
Total internal gains	950.8542	984.4933	938.5020	913.0764	862.8059	833.0949	798.4677	794.5335	819.8894	844.2283	895.8023	926.3271

#### 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	

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Northeast	27.5000	11.2829	0.6300	0.7000	0.7700	94.8259 (75)
Southeast	29.4000	36.7938	0.6300	0.7000	0.7700	330.5934 (77)
Southwest	22.5200	36.7938	0.6300	0.7000	0.7700	253.2300 (79)
Northwest	13.9500	11.2829	0.6300	0.7000	0.7700	48.1026 (81)
Southeast	6.0100	39.9751	0.6300	0.7000	1.0000	95.3554 (82)
Northwest	2.0800	16.3666	0.6300	0.7000	1.0000	13.5115 (82)

Solar gains	835.6188	1488.4949	2203.5640	3000.2583	3599.7720	3677.0610	3502.2226	3040.4259	2477.8386	1690.6997	1012.8856	707.2669 (83)
Total gains	1786.4730	2472.9882	3142.0660	3913.3347	4462.5779	4510.1559	4300.6903	3834.9595	3297.7280	2534.9280	1908.6879	1633.5939 (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	57.0563	57.1643	57.2705	57.7746	57.8699	58.3178	58.3178	58.4015	58.1445	57.8699	57.6774	57.4776
alpha	4.8038	4.8110	4.8180	4.8516	4.8580	4.8879	4.8879	4.8934	4.8763	4.8580	4.8452	4.8318
util living area	0.9994	0.9971	0.9876	0.9436	0.8218	0.6307	0.4716	0.5453	0.8220	0.9800	0.9982	0.9996 (86)
MIT	19.3288	19.5929	19.9738	20.4538	20.8063	20.9596	20.9920	20.9845	20.8576	20.3461	19.7384	19.2880 (87)
Th 2	19.9562	19.9580	19.9597	19.9679	19.9694	19.9765	19.9765	19.9778	19.9737	19.9694	19.9663	19.9631 (88)
util rest of house	0.9992	0.9961	0.9833	0.9243	0.7688	0.5429	0.3655	0.4315	0.7478	0.9701	0.9975	0.9995 (89)
MIT 2	18.4195	18.6844	19.0636	19.5331	19.8431	19.9586	19.9744	19.9734	19.8954	19.4401	18.8364	18.3839 (90)
Living area fraction												FLA = Living area / (4) = 0.1063 (91)
MIT	18.5162	18.7810	19.1604	19.6309	19.9455	20.0650	20.0826	20.0808	19.9977	19.5364	18.9323	18.4800 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5162	18.7810	19.1604	19.6309	19.9455	20.0650	20.0826	20.0808	19.9977	19.5364	18.9323	18.4800 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	1784.3239	2459.3979	3075.4712	3586.8363	3424.5606	2484.5482	1620.0646	1700.2721	2472.6554	2444.6756	1901.8155	1632.3116 (94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	6796.2273	6623.4561	6029.8235	5066.2868	3886.4329	2556.0821	1628.8881	1719.1421	2766.6908	4212.1010	5595.6675	6776.6976 (97)
Space heating kWh	3728.8561	2798.2471	2198.0381	1065.2044	343.6330	0.0000	0.0000	0.0000	0.0000	1314.9645	2659.5734	3827.4232 (98a)
Space heating requirement - total per year (kWh/year)												17935.9398
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	3728.8561	2798.2471	2198.0381	1065.2044	343.6330	0.0000	0.0000	0.0000	0.0000	1314.9645	2659.5734	3827.4232 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17935.9398
Space heating per m2												(98c) / (4) = 43.3298 (99)

## 8c. Space cooling requirement

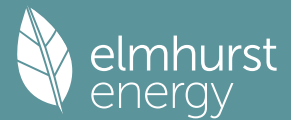
Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8814	0.9341	0.8976	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3875.2136	3233.2158	3186.2147	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5038.9591	4803.9506	4278.2167	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	837.8968	1168.6267	812.4496	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction												fc = cooled area / (4) = 1.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	209.4742	292.1567	203.1124	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												704.7433 (107)
Energy for space heating												43.3298 (99)
Energy for space cooling												1.7025 (108)
Total												45.0323 (109)
Fabric Energy Efficiency (TFEE)												45.0 (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	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1042.1860 (5)

# Full SAP Calculation Printout



## 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													3.0000 (17)
Infiltration rate													0.1500 (18)
Number of sides sheltered													0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762 (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) =													77.4000 (23c)
Effective ac	0.3042	0.3005	0.2967	0.2780	0.2742	0.2555	0.2555	0.2518	0.2630	0.2742	0.2817	0.2893 (25)	

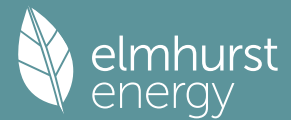
## 3. Heat losses and heat loss parameter

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					
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)					
Solid Door			2.0200	1.2000	2.4240		(26)					
North West			2.8200	1.1450	3.2290		(27a)					
South East			8.1500	1.1450	9.3321		(27a)					
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000	22262.9000 (28a)					
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000	66650.1000 (29a)					
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000	2344.3200 (30)					
Flat roof	10.4400		10.4400	0.0900	0.9396	9.0000	93.9600 (30)					
Total net area of external elements Aum(A, m2)			963.7000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	261.2465	(33)					
Internal Wall 1			548.9200			9.0000	4940.2800 (32c)					
Internal Ceiling 1			132.0600			9.0000	1188.5400 (32e)					
Internal Ceiling 2			79.4900			9.0000	715.4100 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	98195.5100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							237.2216 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)				57.2000	0.0190	1.0868						
E3 Sill				44.2000	0.0160	0.7072						
E4 Jamb				137.9000	0.0180	2.4822						
E5 Ground floor (normal)				87.1000	0.0540	4.7034						
E6 Intermediate floor within a dwelling				107.0000	0.0080	0.8560						
E11 Eaves (insulation at rafter level)				69.0000	0.0520	3.5880						
E13 Gable (insulation at rafter level)				20.6500	0.0560	1.1564						
E14 Flat roof				5.8000	0.0460	0.2668						
E16 Corner (normal)				41.1000	0.0400	1.6440						
E17 Corner (inverted - internal area greater than external area)				12.1000	-0.0680	-0.8228						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.6680 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	276.9145 (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	104.6381	103.3484	102.0587	95.6101	94.3204	87.8719	87.8719	86.5822	90.4513	94.3204	96.8998	99.4793 (38)
Average = Sum(39)m / 12 =	381.5525	380.2628	378.9731	372.5246	371.2349	364.7864	364.7864	363.4967	367.3658	371.2349	373.8143	376.3937 (39)
												372.2022
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9218	0.9186	0.9155	0.8999	0.8968	0.8813	0.8813	0.8781	0.8875	0.8968	0.9031	0.9093 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												3.2801 (42)
Hot water usage for mixer showers												
	79.2156	78.0252	76.2904	72.9714	70.5219	67.7904	66.2378	67.9594	69.8466	72.7794	76.1698	78.9121 (42a)
Hot water usage for baths	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730 (42b)
Hot water usage for other uses	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210 (42c)
Average daily hot water use (litres/day)												148.5696 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061 (44)
Energy conte	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098 (45)
Energy content (annual)												Total = Sum(45)m = 2467.7102
Distribution loss (46)m = 0.15 x (45)m												

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Water storage loss:	38.3962	33.7855	35.4970	30.3043	28.7525	25.2335	24.4300	25.7889	26.4989	30.3536	33.2546	37.8615 (46)
Store volume												188.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1910 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6431 (55)
Total storage loss	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (56)
If cylinder contains dedicated solar storage	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (64)
												Total per year (kWh/year) = Sum(64)m = 2976.3523 (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	119.6714	106.1066	113.2448	100.6195	98.2945	89.3792	88.7129	91.7253	92.1843	101.8436	107.1593	118.4860 (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	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.6420	72.5137	58.9721	44.6457	33.3732	28.1750	30.4441	39.5724	53.1140	67.4404	78.7130	83.9111 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	813.6004	822.0430	800.7678	755.4756	698.3022	644.5673	608.6691	600.2265	621.5017	666.7939	723.9673	777.7022 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	160.8487	157.8967	152.2107	139.7493	132.1162	124.1378	119.2378	123.2867	128.0337	136.8866	148.8323	159.2554 (72)
Total internal gains	1179.6524	1176.0148	1135.5121	1063.4320	987.3530	920.4416	881.9124	886.6470	926.2108	994.6824	1075.0740	1144.4301 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	37.2900	11.2829	0.6300	0.8000	0.7700	146.9530 (75)						
Southeast	39.8700	36.7938	0.6300	0.8000	0.7700	512.3716 (77)						
Southwest	30.5400	36.7938	0.6300	0.8000	0.7700	392.4712 (79)						
Northwest	18.9100	11.2829	0.6300	0.8000	0.7700	74.5208 (81)						
Southeast	8.1500	39.9751	0.6300	0.8000	1.0000	147.7817 (82)						
Northwest	2.8200	16.3666	0.6300	0.8000	1.0000	20.9353 (82)						
Solar gains	1295.0337	2306.8413	3415.0079	4649.6444	5578.6949	5698.4537	5427.5089	4711.8769	3840.0515	2620.2054	1569.7576	1096.1166 (83)
Total gains	2474.6861	3482.8561	4550.5199	5713.0763	6566.0479	6618.8953	6309.4213	5598.5239	4766.2622	3614.8877	2644.8315	2240.5467 (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)	0.9974	0.9831	0.9203	0.7376	0.5201	0.3523	0.2543	0.2985	0.5259	0.8816	0.9906	0.9985 (86)
Living	19.8988	20.2384	20.6308	20.9169	20.9894	20.9992	20.9999	20.9998	20.9920	20.8090	20.2706	19.8444
Non living	18.8528	19.2853	19.7661	20.0925	20.1624	20.1830	20.1834	20.1860	20.1734	19.9923	19.3391	18.7912
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	16	0	0	0	0	0	0	0	0	0	0	0
16 / 9	15	28	20	0	0	0	0	0	0	0	0	31
MIT	20.6982	20.5686	20.7341	20.9169	20.9894	20.9992	20.9999	20.9998	20.9920	20.8090	20.2706	20.3455 (87)
Th 2	20.1490	20.1517	20.1543	20.1675	20.1702	20.1835	20.1835	20.1861	20.1782	20.1702	20.1649	20.1596 (88)
util rest of house	0.9966	0.9784	0.9017	0.6986	0.4756	0.3075	0.2072	0.2458	0.4657	0.8475	0.9872	0.9980 (89)
MIT 2	19.8722	19.7693	19.9060	20.0925	20.1624	20.1830	20.1834	20.1860	20.1734	19.9923	19.3391	19.5556 (90)
Living area fraction									fLA = Living area / (4) =			0.1063 (91)
MIT	19.9600	19.8542	19.9940	20.1801	20.2503	20.2698	20.2702	20.2725	20.2604	20.0791	19.4382	19.6396 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9600	19.8542	19.9940	20.1801	20.2503	20.2698	20.2702	20.2725	20.2604	20.0791	19.4382	19.6396 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9964	0.9764	0.8978	0.6992	0.4800	0.3123	0.2122	0.2514	0.4718	0.8433	0.9833	0.9976 (94)
Useful gains	2465.6687	3400.6170	4085.3450	3994.5523	3151.4873	2066.9074	1338.7477	1407.3879	2248.9001	3048.4065	2600.6039	2235.2279 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	5975.1139	5686.5390	5113.8744	4202.1261	3174.1708	2068.2550	1338.8462	1407.6532	2263.1184	3518.9676	4612.1784	5811.3610 (97)
Space heating kWh	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430 (98a)

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Space heating requirement - total per year (kWh/year)													9537.7964
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)													0.0000
Space heating kWh	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													9537.7964
Space heating per m2													(98c) / (4) = 23.0415 (99)

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 9a. Energy requirements - Individual heating systems, including micro-CHP  
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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 %)													451.4428 (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	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430	(98)
Space heating efficiency (main heating system 1)	451.4428	451.4428	451.4428	451.4428	451.4428	0.0000	0.0000	0.0000	0.0000	451.4428	451.4428	451.4428	(210)
Space heating fuel (main heating system)	578.3739	340.2734	169.5067	33.1057	3.7383	0.0000	0.0000	0.0000	0.0000	77.5508	320.8233	589.3644	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095	(64)
Efficiency of water heater													189.6362 (216)
(217)m	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	(217)
Fuel for water heating, kWh/month	157.7623	139.3489	147.5700	128.5803	123.8598	110.7539	108.6640	113.4414	115.2025	129.4885	138.9520	155.8824	(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)
(221)m	163.2773	147.4762	163.2773	158.0102	163.2773	158.0102	163.2773	163.2773	158.0102	163.2773	158.0102	163.2773	(231)
Pumps and Fa	71.4608	57.3285	51.6179	37.8175	29.2113	23.8659	26.6476	34.6375	44.9907	59.0302	66.6745	73.4469	(232)
Lighting													
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-190.3611	-296.2567	-453.2627	-532.6873	-597.6782	-567.4477	-563.2266	-522.5585	-450.5864	-353.9648	-219.7384	-161.5766	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.5109	-19.4707	-58.0587	-119.4494	-183.0176	-190.8081	-188.8661	-150.4704	-99.7968	-42.1688	-10.3239	-3.9083	(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													2112.7365 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													189.6362
Water heating fuel used													1569.5061 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5120)													
mechanical ventilation fans (SFP = 1.5120)													1922.4580 (230a)
Total electricity for the above, kWh/year													1922.4580 (231)
Electricity for lighting (calculated in Appendix L)													576.7293 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-5981.1947 (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													200.2351 (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	2112.7365	16.4900	348.3902 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1569.5061	16.4900	258.8116 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	1922.4580	16.4900	317.0133 (249)
Energy for lighting	576.7293	16.4900	95.1027 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-4909.3451	16.4900	-809.5510
PV Unit electricity exported	-1071.8497	5.5900	-59.9164
Total			-869.4674 (252)
Total energy cost			149.8504 (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)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1175 (257)
SAP value		98.0946
SAP rating (Section 12)		98 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2112.7365	0.1585	334.9384 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1569.5061	0.1411	221.4391 (264)
Space and water heating			556.3775 (265)
Pumps, fans and electric keep-hot	1922.4580	0.1387	266.6686 (267)
Energy for lighting	576.7293	0.1443	83.2399 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-4909.3451	0.1333	-654.6136
PV Unit electricity exported	-1071.8497	0.1192	-127.7316
Total			-782.3452 (269)
Total CO2, kg/year			123.9408 (272)
CO2 emissions per m2			0.3000 (273)
EI value			99.6381
EI rating			100 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1042.1860 (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		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		0	(19)
Shelter factor	$(20) = 1 - [0.075 \times (19)] =$		1.0000 (20)
Infiltration rate adjusted to include shelter factor	$(21) = (18) \times (20) =$		0.1500 (21)

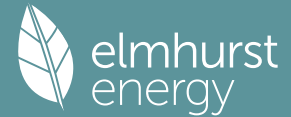
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.4000	5.0000	5.0000	4.5000	4.4000	3.9000	4.0000	3.8000	4.0000	4.6000	4.7000	5.1000 (22)
Wind factor	1.3500	1.2500	1.2500	1.1250	1.1000	0.9750	1.0000	0.9500	1.0000	1.1500	1.1750	1.2750 (22a)
Adj infilt rate	0.2025	0.1875	0.1875	0.1687	0.1650	0.1462	0.1500	0.1425	0.1500	0.1725	0.1762	0.1912 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												77.4000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3155	0.3005	0.3005	0.2817	0.2780	0.2592	0.2630	0.2555	0.2630	0.2855	0.2893	0.3042 (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
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)
Solid Door			2.0200	1.2000	2.4240		(26)
North West			2.8200	1.1450	3.2290		(27a)
South East			8.1500	1.1450	9.3321		(27a)
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000	22262.9000 (28a)
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000	66650.1000 (29a)
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000	2344.3200 (30)



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Flat roof	10.4400	10.4400	0.0900	0.9396	9.0000	93.9600 (30)
Total net area of external elements Aum(A, m2)		963.7000				(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =	261.2465			(33)
Internal Wall 1		548.9200			9.0000	4940.2800 (32c)
Internal Ceiling 1		132.0600			9.0000	1188.5400 (32e)
Internal Ceiling 2		79.4900			9.0000	715.4100 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 98195.5100 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 237.2216 (35)

List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	57.2000	0.0190	1.0868
E3 Sill	44.2000	0.0160	0.7072
E4 Jamb	137.9000	0.0180	2.4822
E5 Ground floor (normal)	87.1000	0.0540	4.7034
E6 Intermediate floor within a dwelling	107.0000	0.0080	0.8560
E11 Eaves (insulation at rafter level)	69.0000	0.0520	3.5880
E13 Gable (insulation at rafter level)	20.6500	0.0560	1.1564
E14 Flat roof	5.8000	0.0460	0.2668
E16 Corner (normal)	41.1000	0.0400	1.6440
E17 Corner (inverted - internal area greater than external area)	12.1000	-0.0680	-0.8228

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.6680 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 276.9145 (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
	108.5072	103.3484	103.3484	96.8998	95.6101	89.1616	90.4513	87.8719	90.4513	98.1896	99.4793	104.6381 (38)
Heat transfer coeff	385.4216	380.2628	380.2628	373.8143	372.5246	366.0761	367.3658	364.7864	367.3658	375.1040	376.3937	381.5525 (39)
Average = Sum(39)m / 12 =												374.2442

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9311	0.9186	0.9186	0.9031	0.8999	0.8844	0.8875	0.8813	0.8875	0.9062	0.9093	0.9218 (40)
HLP (average)												0.9041
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

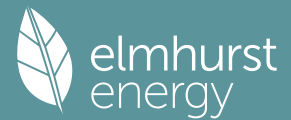
Assumed occupancy												3.2801 (42)	
Hot water usage for mixer showers													78.9121 (42a)
Hot water usage for baths													34.0730 (42b)
Hot water usage for other uses													48.2210 (42c)
Average daily hot water use (litres/day)													148.5696 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061 (44)	
Energy conte	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098 (45)	
Energy content (annual)													Total = Sum(45)m = 2467.7102
Distribution loss (46)m = 0.15 x (45)m													37.8615 (46)
Water storage loss:													188.0000 (47)
Store volume													1.1910 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.6431 (55)
Enter (49) or (54) in (55)													
Total storage loss													19.9373 (56)
If cylinder contains dedicated solar storage													19.9373 (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													295.6095 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (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	119.6714	106.1066	113.2448	100.6195	98.2945	89.3792	88.7129	91.7253	92.1843	101.8436	107.1593	118.4860 (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
	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.6420	72.5137	58.9721	44.6457	33.3732	28.1750	30.4441	39.5724	53.1140	67.4404	78.7130	83.9111 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	813.6004	822.0430	800.7678	755.4756	698.3022	644.5673	608.6691	600.2265	621.5017	666.7939	723.9673	777.7022 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	160.8487	157.8967	152.2107	139.7493	132.1162	124.1378	119.2378	123.2867	128.0337	136.8866	148.8323	159.2554 (72)
Total internal gains	1179.6524	1176.0148	1135.5121	1063.4320	987.3530	920.4416	881.9124	886.6470	926.2108	994.6824	1075.0740	1144.4301 (73)

#### 6. Solar gains

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[Jan]	Area		Solar flux		g		FF		Access		Gains	
	m2		Table 6a		Specific data		Specific data		factor		W	
			W/m2		or Table 6b		or Table 6c		Table 6d			
Northeast	37.2900		15.0290		0.6300		0.8000		0.7700		195.7431	(75)
Southeast	39.8700		46.0405		0.6300		0.8000		0.7700		641.1351	(77)
Southwest	30.5400		46.0405		0.6300		0.8000		0.7700		491.1028	(79)
Northwest	18.9100		15.0290		0.6300		0.8000		0.7700		99.2626	(81)
Southeast	8.1500		51.4103		0.6300		0.8000		1.0000		190.0555	(82)
Northwest	2.8200		21.8726		0.6300		0.8000		1.0000		27.9783	(82)

Solar gains	1645.2774	2472.8462	3587.9136	4959.6896	5644.8981	6150.7396	5308.5646	5002.4252	4163.6016	2836.8325	1932.8873	1377.8908	(83)
Total gains	2824.9298	3648.8610	4723.4256	6023.1216	6632.2511	7071.1812	6190.4771	5889.0723	5089.8123	3831.5149	3007.9612	2522.3209	(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	70.7706	71.7307	71.7307	72.9681	73.2208	74.5106	74.2490	74.7740	74.2490	72.7172	72.4681	71.4883	
alpha	5.7180	5.7820	5.7820	5.8645	5.8814	5.9674	5.9499	5.9849	5.9499	5.8478	5.8312	5.7659	
util living area	0.9929	0.9722	0.8960	0.7104	0.5273	0.3516	0.3025	0.3157	0.5077	0.8357	0.9740	0.9955	(86)
Living	20.0968	20.3806	20.7026	20.9309	20.9882	20.9991	20.9997	20.9996	20.9932	20.8659	20.4767	20.0615	
Non living	19.0995	19.4633	19.8473	20.1032	20.1587	20.1803	20.1780	20.1833	20.1740	20.0445	19.5931	19.0610	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	22	0	0	0	0	0	0	0	0	31	
MIT	20.7690	20.6492	20.7941	20.9309	20.9882	20.9991	20.9997	20.9996	20.9932	20.8659	20.4767	20.4685	(87)
Th 2	20.1411	20.1517	20.1517	20.1649	20.1675	20.1808	20.1782	20.1835	20.1782	20.1623	20.1596	20.1490	(88)
util rest of house	0.9907	0.9644	0.8728	0.6709	0.4832	0.3094	0.2538	0.2653	0.4509	0.7928	0.9650	0.9940	(89)
MIT 2	19.9335	19.8479	19.9679	20.1032	20.1587	20.1803	20.1780	20.1833	20.1740	20.0445	19.5931	19.6688	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	20.0223	19.9330	20.0558	20.1912	20.2469	20.2673	20.2654	20.2701	20.2611	20.1318	19.6870	19.7538	(92)
Temperature adjustment													
adjusted MIT	20.0223	19.9330	20.0558	20.1912	20.2469	20.2673	20.2654	20.2701	20.2611	20.1318	19.6870	19.7538	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9903	0.9620	0.8699	0.6722	0.4874	0.3139	0.2590	0.2706	0.4567	0.7911	0.9585	0.9931	(94)
Useful gains	2797.5135	3510.2040	4108.8475	4048.8757	3232.8875	2219.5864	1603.3023	1593.6803	2324.4745	3030.9983	2883.0695	2504.9506	(95)
Ext temp.	5.4000	5.9000	7.1000	8.9000	11.5000	14.2000	15.9000	15.9000	13.9000	11.2000	8.3000	5.7000	(96)
Heat loss rate W	5635.7560	5336.2412	4926.5941	4220.7969	3258.4410	2221.1063	1603.6866	1594.1475	2336.8387	3350.3671	4286.0004	5362.2616	(97)
Space heating kWh	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394	(98a)
Space heating requirement - total per year (kWh/year)	7463.5081												
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	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	7463.5081												
Space heating per m2	(98c) / (4) = 18.0304 (99)												

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													
Fraction of space heat from main system(s)													
Efficiency of main space heating system 1 (in %)	451.7181 (206)												
Efficiency of main space heating system 2 (in %)	0.0000 (207)												
Efficiency of secondary/supplementary heating system, %	0.0000 (208)												
Space heating requirement	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394	(98)
Space heating efficiency (main heating system 1)	451.7181	451.7181	451.7181	451.7181	451.7181	0.0000	0.0000	0.0000	0.0000	451.7181	451.7181	451.7181	(210)
Space heating fuel (main heating system)	467.4713	271.6510	134.6865	27.4028	4.2088	0.0000	0.0000	0.0000	0.0000	52.6015	223.6152	470.6120	(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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095	(64)
Efficiency of water heater	189.6017 (216)												
(217)m	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	(217)
Fuel for water heating, kWh/month	157.7910	139.3743	147.5969	128.6037	123.8823	110.7741	108.6837	113.4621	115.2235	129.5121	138.9773	155.9108	(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	163.2773	147.4762	163.2773	158.0102	163.2773	158.0102	163.2773	163.2773	158.0102	163.2773	158.0102	163.2773	(231)
Lighting	71.4608	57.3285	51.6179	37.8175	29.2113	23.8659	26.6476	34.6375	44.9907	59.0302	66.6745	73.4469	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-239.3408	-314.1498	-468.3291	-554.3242	-597.7370	-592.3914	-550.3142	-540.7905	-476.3746	-376.8151	-266.0373	-201.5648	(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)													

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(233b)m	-9.8878	-23.8382	-65.4946	-133.8942	-182.8779	-216.5932	-176.6593	-165.5607	-115.4146	-50.7205	-17.4670	-6.9207	(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												1652.2491	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												189.6017	
Water heating fuel used												1569.7919	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5120)													
mechanical ventilation fans (SFP = 1.5120)												1922.4580	(230a)
Total electricity for the above, kWh/year												1922.4580	(231)
Electricity for lighting (calculated in Appendix L)												576.7293	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6343.4977	(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												-622.2694	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1652.2491	25.1600	415.7059	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1569.7919	25.1600	394.9596	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	1922.4580	25.1600	483.6904	(249)
Energy for lighting	576.7293	25.1600	145.1051	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-5178.1688	25.1600	-1302.8273	
PV Unit electricity exported	-1165.3288	5.8100	-67.7056	
Total			-1370.5329	(252)
Total energy cost			68.9282	(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	1652.2491	0.1588	262.3726	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1569.7919	0.1411	221.4794	(264)
Space and water heating			483.8521	(265)
Pumps, fans and electric keep-hot	1922.4580	0.1387	266.6686	(267)
Energy for lighting	576.7293	0.1443	83.2399	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-5178.1688	0.1341	-694.2322	
PV Unit electricity exported	-1165.3288	0.1207	-140.6249	
Total			-834.8571	(269)
Total CO2, kg/year			-1.0965	(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	1652.2491	1.5878	2623.3690	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1569.7919	1.5217	2388.7573	(278)
Space and water heating			5012.1263	(279)
Pumps, fans and electric keep-hot	1922.4580	1.5128	2908.2944	(281)
Energy for lighting	576.7293	1.5338	884.6067	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-5178.1688	1.4954	-7743.6644	
PV Unit electricity exported	-1165.3288	0.4428	-516.0570	
Total			-8259.7214	(283)
Total Primary energy kWh/year			545.3060	(286)

## SAP 10 EPC IMPROVEMENTS

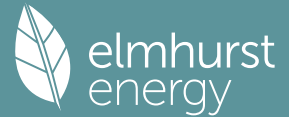
### Plot 1

Current energy efficiency rating: A 98  
 Current environmental impact rating: A 100

N Solar water heating SAP increase too small  
 U Solar photovoltaic panels Already installed  
 V2 Wind turbine Not applicable

Recommended measures: SAP change Cost change CO2 change

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(none)

Measures omitted - SAP change or cost saving too small:  
 N Solar water heating + 0.5 -£ 68 -39 kg (3599.9%)

Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings £0	0.00 kg/m <sup>2</sup>	
Potential energy efficiency rating:		A 98	
Potential environmental impact rating:			A 100

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 £1439	Potential £1439	£0	Saving
Electricity				
Space heating	£899	£899	£0	
Water heating	£395	£395	£0	
Lighting	£145	£145	£0	
Generated (PV)	-£1371	-£1371	£0	
Total cost of fuels	£68	£68	£0	
Total cost of uses	£68	£68	£0	
Delivered energy	-2 kWh/m <sup>2</sup>	-2 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>	
Carbon dioxide emissions	-0.0 tonnes	-0.0 tonnes	0.0 tonnes	
CO2 emissions per m <sup>2</sup>	-0 kg/m <sup>2</sup>	-0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	
Primary energy	1 kWh/m <sup>2</sup>	1 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>	

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	202.3900 (1b)	x 2.7000 (2b)	= 546.4530 (1b) - (3b)
First floor	132.0600 (1c)	x 2.5500 (2c)	= 336.7530 (1c) - (3c)
Second floor	79.4900 (1d)	x 2.0000 (2d)	= 158.9800 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1042.1860 (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	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												77.4000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3042	0.3005	0.2967	0.2780	0.2742	0.2555	0.2555	0.2518	0.2630	0.2742	0.2817	0.2893 (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
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)
Solid Door			2.0200	1.2000	2.4240		(26)

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North West			2.8200	1.1450	3.2290								(27a)
South East			8.1500	1.1450	9.3321								(27a)
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000				22262.9000			(28a)
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000				66650.1000			(29a)
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000				2344.3200			(30)
Flat roof	10.4400		10.4400	0.0900	0.9396	9.0000				93.9600			(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			963.7000										(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		261.2465								(33)
Internal Wall 1			548.9200			9.0000				4940.2800			(32c)
Internal Ceiling 1			132.0600			9.0000				1188.5400			(32e)
Internal Ceiling 2			79.4900			9.0000				715.4100			(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 98195.5100 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 237.2216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	57.2000	0.0190	1.0868
E3 Sill	44.2000	0.0160	0.7072
E4 Jamb	137.9000	0.0180	2.4822
E5 Ground floor (normal)	87.1000	0.0540	4.7034
E6 Intermediate floor within a dwelling	107.0000	0.0080	0.8560
E11 Eaves (insulation at rafter level)	69.0000	0.0520	3.5880
E13 Gable (insulation at rafter level)	20.6500	0.0560	1.1564
E14 Flat roof	5.8000	0.0460	0.2668
E16 Corner (normal)	41.1000	0.0400	1.6440
E17 Corner (inverted - internal area greater than external area)	12.1000	-0.0680	-0.8228

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.6680 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 276.9145 (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	104.6381	103.3484	102.0587	95.6101	94.3204	87.8719	87.8719	86.5822	90.4513	94.3204	96.8998	99.4793
Average = Sum(39)m / 12 =	381.5525	380.2628	378.9731	372.5246	371.2349	364.7864	364.7864	363.4967	367.3658	371.2349	373.8143	376.3937

HLP (average)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9218	0.9186	0.9155	0.8999	0.8968	0.8813	0.8813	0.8781	0.8875	0.8968	0.9031	0.9093
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 3.2801 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	79.2156	78.0252	76.2904	72.9714	70.5219	67.7904	66.2378	67.9594	69.8466	72.7794	76.1698	78.9121
Hot water usage for baths	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730
Hot water usage for other uses	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210
Average daily hot water use (litres/day)												148.5696

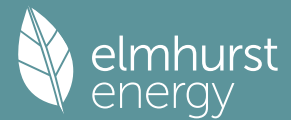
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061
Energy conte	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098
Energy content (annual)												2467.7102
Distribution loss (46)m = 0.15 x (45)m	38.3962	33.7855	35.4970	30.3043	28.7525	25.2335	24.4300	25.7889	26.4989	30.3536	33.2546	37.8615
Water storage loss:												188.0000
Store volume												1.1910
a) If manufacturer declared loss factor is known (kWh/day):												0.5400
Temperature factor from Table 2b												0.6431
Enter (49) or (54) in (55)												0.6431
Total storage loss	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373
If cylinder contains dedicated solar storage	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373
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
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
Total heat required for water heating calculated for each month	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095
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
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
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
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
Output from w/h	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095
Total per year (kWh/year) = Sum(64)m =												2976.3523
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
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000
Heat gains from water heating, kWh/month	119.6714	106.1066	113.2448	100.6195	98.2945	89.3792	88.7129	91.7253	92.1843	101.8436	107.1593	118.4860

#### 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
Metabolic gains	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.6420	72.5137	58.9721	44.6457	33.3732	28.1750	30.4441	39.5724	53.1140	67.4404	78.7130	83.9111
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	813.6004	822.0430	800.7678	755.4756	698.3022	644.5673	608.6691	600.2265	621.5017	666.7939	723.9673	777.7022
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604
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
Losses e.g. evaporation (negative values) (Table 5)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021
Water heating gains (Table 5)	160.8487	157.8967	152.2107	139.7493	132.1162	124.1378	119.2378	123.2867	128.0337	136.8866	148.8323	159.2554
Total internal gains	1179.6524	1176.0148	1135.5121	1063.4320	987.3530	920.4416	881.9124	886.6470	926.2108	994.6824	1075.0740	1144.4301

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## 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast		37.2900	11.2829	0.6300	0.8000	0.7700	146.9530 (75)						
Southeast		39.8700	36.7938	0.6300	0.8000	0.7700	512.3716 (77)						
Southwest		30.5400	36.7938	0.6300	0.8000	0.7700	392.4712 (79)						
Northwest		18.9100	11.2829	0.6300	0.8000	0.7700	74.5208 (81)						
Southeast		8.1500	39.9751	0.6300	0.8000	1.0000	147.7817 (82)						
Northwest		2.8200	16.3666	0.6300	0.8000	1.0000	20.9353 (82)						
Solar gains	1295.0337	2306.8413	3415.0079	4649.6444	5578.6949	5698.4537	5427.5089	4711.8769	3840.0515	2620.2054	1569.7576	1096.1166	(83)
Total gains	2474.6861	3482.8561	4550.5199	5713.0763	6566.0479	6618.8953	6309.4213	5598.5239	4766.2622	3614.8877	2644.8315	2240.5467	(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	71.4883	71.7307	71.9748	73.2208	73.4751	74.7740	74.7740	75.0393	74.2490	73.4751	72.9681	72.4681	
alpha	5.7659	5.7820	5.7983	5.8814	5.8983	5.9849	5.9849	6.0026	5.9499	5.8983	5.8645	5.8312	
util living area	0.9974	0.9831	0.9203	0.7376	0.5201	0.3523	0.2543	0.2985	0.5259	0.8816	0.9906	0.9985	(86)
Living	19.8988	20.2384	20.6308	20.9169	20.9894	20.9992	20.9999	20.9998	20.9920	20.8090	20.2706	19.8444	
Non living	18.8528	19.2853	19.7661	20.0925	20.1624	20.1830	20.1834	20.1860	20.1734	19.9923	19.3391	18.7912	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	16	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	15	28	20	0	0	0	0	0	0	0	0	31	
MIT	20.6982	20.5686	20.7341	20.9169	20.9894	20.9992	20.9999	20.9998	20.9920	20.8090	20.2706	20.3455	(87)
Th 2	20.1490	20.1517	20.1543	20.1675	20.1702	20.1835	20.1835	20.1861	20.1782	20.1702	20.1649	20.1596	(88)
util rest of house	0.9966	0.9784	0.9017	0.6986	0.4756	0.3075	0.2072	0.2458	0.4657	0.8475	0.9872	0.9980	(89)
MIT 2	19.8722	19.7693	19.9060	20.0925	20.1624	20.1830	20.1834	20.1860	20.1734	19.9923	19.3391	19.5556	(90)
Living area fraction	19.9600	19.8542	19.9940	20.1801	20.2503	20.2698	20.2702	20.2725	20.2604	20.0791	19.4382	19.6396	(91)
MIT	19.9600	19.8542	19.9940	20.1801	20.2503	20.2698	20.2702	20.2725	20.2604	20.0791	19.4382	19.6396	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9600	19.8542	19.9940	20.1801	20.2503	20.2698	20.2702	20.2725	20.2604	20.0791	19.4382	19.6396	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9764	0.8978	0.6992	0.4800	0.3123	0.2122	0.2514	0.4718	0.8433	0.9833	0.9976	(94)
Useful gains	2465.6687	3400.6170	4085.3450	3994.5523	3151.4873	2066.9074	1338.7477	1407.3879	2248.9001	3048.4065	2600.6039	2235.2279	(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	5975.1139	5686.5390	5113.8744	4202.1261	3174.1708	2068.2550	1338.8462	1407.6532	2263.1184	3518.9676	4612.1784	5811.3610	(97)
Space heating kWh	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430	(98a)
Space heating requirement - total per year (kWh/year)												9537.7964	
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	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9537.7964	
Space heating per m2										(98c) / (4) =		23.0415	(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 %) 451.4428 (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	2611.0272	1536.1396	765.2258	149.4531	16.8765	0.0000	0.0000	0.0000	0.0000	350.0975	1448.3337	2660.6430	(98)
Space heating efficiency (main heating system 1)	451.4428	451.4428	451.4428	451.4428	451.4428	0.0000	0.0000	0.0000	0.0000	451.4428	451.4428	451.4428	(210)
Space heating fuel (main heating system)	578.3739	340.2734	169.5067	33.1057	3.7383	0.0000	0.0000	0.0000	0.0000	77.5508	320.8233	589.3644	(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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095	(64)
Efficiency of water heater (217)m	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	189.6362	(216)
Fuel for water heating, kWh/month	157.7623	139.3489	147.5700	128.5803	123.8598	110.7539	108.6640	113.4414	115.2025	129.4885	138.9520	155.8824	(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	163.2773	147.4762	163.2773	158.0102	163.2773	158.0102	163.2773	163.2773	158.0102	163.2773	158.0102	163.2773	(231)
Lighting	71.4608	57.3285	51.6179	37.8175	29.2113	23.8659	26.6476	34.6375	44.9907	59.0302	66.6745	73.4469	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-190.3611	-296.2567	-453.2627	-532.6873	-597.6782	-567.4477	-563.2266	-522.5585	-450.5864	-353.9648	-219.7384	-161.5766	(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	-5.5109	-19.4707	-58.0587	-119.4494	-183.0176	-190.8081	-188.8661	-150.4704	-99.7968	-42.1688	-10.3239	-3.9083	(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												2112.7365	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												189.6362	
Water heating fuel used												1569.5061	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5120) mechanical ventilation fans (SFP = 1.5120)												1922.4580	(230a)
Total electricity for the above, kWh/year												1922.4580	(231)
Electricity for lighting (calculated in Appendix L)												576.7293	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5981.1947	(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												200.2351	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2112.7365	16.4900	348.3902	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1569.5061	16.4900	258.8116	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	1922.4580	16.4900	317.0133	(249)
Energy for lighting	576.7293	16.4900	95.1027	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4909.3451	16.4900	-809.5510	
PV Unit electricity exported	-1071.8497	5.5900	-59.9164	
Total			-869.4674	(252)
Total energy cost			149.8504	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1175	(257)
SAP value		98.0946	
SAP rating (Section 12)		98	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2112.7365	0.1585	334.9384	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1569.5061	0.1411	221.4391	(264)
Space and water heating			556.3775	(265)
Pumps, fans and electric keep-hot	1922.4580	0.1387	266.6686	(267)
Energy for lighting	576.7293	0.1443	83.2399	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4909.3451	0.1333	-654.6136	
PV Unit electricity exported	-1071.8497	0.1192	-127.7316	
Total			-782.3452	(269)
Total CO2, kg/year			123.9408	(272)
CO2 emissions per m2			0.3000	(273)
EI value			99.6381	
EI rating			100	(274)
EI band			A	

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

## 1. Overall dwelling characteristics

Area (m2)	Storey height (m)	Volume (m3)
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Ground floor		202.3900 (1b)	x	2.7000 (2b)	=	546.4530 (1b)	-	(3b)
First floor		132.0600 (1c)	x	2.5500 (2c)	=	336.7530 (1c)	-	(3c)
Second floor		79.4900 (1d)	x	2.0000 (2d)	=	158.9800 (1d)	-	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	413.9400							(4)
Dwelling volume						(3a) + (3b) + (3c) + (3d) + (3e) ... (3n)	=	1042.1860 (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		3.0000 (17)									
Infiltration rate		0.1500 (18)									
Number of sides sheltered		0 (19)									
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)							
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1500	(21)							

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.4000	5.0000	5.0000	4.5000	4.4000	3.9000	4.0000	3.8000	4.0000	4.6000	4.7000	5.1000	(22)
Wind factor	1.3500	1.2500	1.2500	1.1250	1.1000	0.9750	1.0000	0.9500	1.0000	1.1500	1.1750	1.2750	(22a)
Adj infilt rate													
	0.2025	0.1875	0.1875	0.1687	0.1650	0.1462	0.1500	0.1425	0.1500	0.1725	0.1762	0.1912	(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) =													77.4000 (23c)
Effective ac	0.3155	0.3005	0.3005	0.2817	0.2780	0.2592	0.2630	0.2555	0.2630	0.2855	0.2893	0.3042	(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
Windows (Uw = 1.20)			126.6100	1.1450	144.9733		(27)
Solid Door			2.0200	1.2000	2.4240		(26)
North West			2.8200	1.1450	3.2290		(27a)
South East			8.1500	1.1450	9.3321		(27a)
Heatloss Floor 1			202.3900	0.1200	24.2868	110.0000	22262.9000 (28a)
Cavity Wall	479.4200	128.6300	350.7900	0.1500	52.6185	190.0000	66650.1000 (29a)
Warm Roof	271.4500	10.9700	260.4800	0.0900	23.4432	9.0000	2344.3200 (30)
Flat roof	10.4400		10.4400	0.0900	0.9396	9.0000	93.9600 (30)
Total net area of external elements Aum(A, m2)			963.7000				(31)
Fabric heat loss, W/K = Sum (A x U)					261.2465		(32)
Internal Wall 1			548.9200			9.0000	4940.2800 (32c)
Internal Ceiling 1			132.0600			9.0000	1188.5400 (32e)
Internal Ceiling 2			79.4900			9.0000	715.4100 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 98195.5100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							237.2216 (35)

List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				57.2000	0.0190	1.0868							
E3 Sill				44.2000	0.0160	0.7072							
E4 Jamb				137.9000	0.0180	2.4822							
E5 Ground floor (normal)				87.1000	0.0540	4.7034							
E6 Intermediate floor within a dwelling				107.0000	0.0080	0.8560							
E11 Eaves (insulation at rafter level)				69.0000	0.0520	3.5880							
E13 Gable (insulation at rafter level)				20.6500	0.0560	1.1564							
E14 Flat roof				5.8000	0.0460	0.2668							
E16 Corner (normal)				41.1000	0.0400	1.6440							
E17 Corner (inverted - internal area greater than external area)				12.1000	-0.0680	-0.8228							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													15.6680 (36)
Point Thermal bridges													0.0000 (36a)
Total fabric heat loss													(33) + (36) + (36a) = 276.9145 (37)

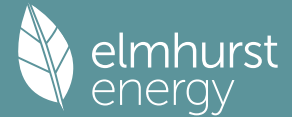
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	108.5072	103.3484	103.3484	96.8998	95.6101	89.1616	90.4513	87.8719	90.4513	98.1896	99.4793	104.6381	(38)
Heat transfer coeff													
	385.4216	380.2628	380.2628	373.8143	372.5246	366.0761	367.3658	364.7864	367.3658	375.1040	376.3937	381.5525	(39)
Average = Sum(39)m / 12 =													374.2442
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9311	0.9186	0.9186	0.9031	0.8999	0.8844	0.8875	0.8813	0.8875	0.9062	0.9093	0.9218	(40)
HLP (average)													0.9041
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.2801 (42)
Hot water usage for mixer showers													
	79.2156	78.0252	76.2904	72.9714	70.5219	67.7904	66.2378	67.9594	69.8466	72.7794	76.1698	78.9121	(42a)
Hot water usage for baths													
	34.1885	33.6808	32.9658	31.6474	30.6602	29.5656	28.9744	29.6844	30.4575	31.6287	32.9742	34.0730	(42b)
Hot water usage for other uses													



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Average daily hot water use (litres/day)	48.2210	46.4675	44.7140	42.9605	41.2070	39.4536	39.4536	41.2070	42.9605	44.7140	46.4675	48.2210 (42c)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	161.6252	158.1735	153.9702	147.5793	142.3892	136.8096	134.6657	138.8508	143.2646	149.1222	155.6116	161.2061 (44)
Energy content (annual)	255.9748	225.2369	236.6465	202.0287	191.6833	168.2233	162.8665	171.9263	176.6595	202.3574	221.6972	252.4098 (45)
Distribution loss (46)m = 0.15 x (45)m	38.3962	33.7855	35.4970	30.3043	28.7525	25.2335	24.4300	25.7889	26.4989	30.3536	33.2546	37.8615 (46)
Water storage loss:												188.0000 (47)
Store volume												1.1910 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.6431 (55)
Enter (49) or (54) in (55)												
Total storage loss	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (56)
If cylinder contains dedicated solar storage	19.9373	18.0079	19.9373	19.2942	19.9373	19.2942	19.9373	19.9373	19.2942	19.9373	19.2942	19.9373 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (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	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095 (64)
												2976.3523 (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	119.6714	106.1066	113.2448	100.6195	98.2945	89.3792	88.7129	91.7253	92.1843	101.8436	107.1593	118.4860 (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	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031	196.8031 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.6420	72.5137	58.9721	44.6457	33.3732	28.1750	30.4441	39.5724	53.1140	67.4404	78.7130	83.9111 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	813.6004	822.0430	800.7678	755.4756	698.3022	644.5673	608.6691	600.2265	621.5017	666.7939	723.9673	777.7022 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604	57.9604 (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)	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021	-131.2021 (71)
Water heating gains (Table 5)	160.8487	157.8967	152.2107	139.7493	132.1162	124.1378	119.2378	123.2867	128.0337	136.8866	148.8323	159.2554 (72)
Total internal gains	1179.6524	1176.0148	1135.5121	1063.4320	987.3530	920.4416	881.9124	886.6470	926.2108	994.6824	1075.0740	1144.4301 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	37.2900	15.0290	0.6300	0.8000	0.7700	195.7431 (75)	
Southeast	39.8700	46.0405	0.6300	0.8000	0.7700	641.1351 (77)	
Southwest	30.5400	46.0405	0.6300	0.8000	0.7700	491.1028 (79)	
Northwest	18.9100	15.0290	0.6300	0.8000	0.7700	99.2626 (81)	
Southeast	8.1500	51.4103	0.6300	0.8000	1.0000	190.0555 (82)	
Northwest	2.8200	21.8726	0.6300	0.8000	1.0000	27.9783 (82)	

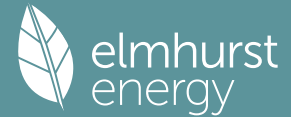
Solar gains	1645.2774	2472.8462	3587.9136	4959.6896	5644.8981	6150.7396	5308.5646	5002.4252	4163.6016	2836.8325	1932.8873	1377.8908 (83)
Total gains	2824.9298	3648.8610	4723.4256	6023.1216	6632.2511	7071.1812	6190.4771	5889.0723	5089.8123	3831.5149	3007.9612	2522.3209 (84)

## 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)	70.7706	71.7307	71.7307	72.9681	73.2208	74.5106	74.2490	74.7740	74.2490	72.7172	72.4681	71.4883
tau	5.7180	5.7820	5.7820	5.8645	5.8814	5.9674	5.9499	5.9849	5.9499	5.8478	5.8312	5.7659
util living area	0.9929	0.9722	0.8960	0.7104	0.5273	0.3516	0.3025	0.3157	0.5077	0.8357	0.9740	0.9955 (86)
Living	20.0968	20.3806	20.7026	20.9309	20.9882	20.9991	20.9997	20.9996	20.9932	20.8659	20.4767	20.0615
Non living	19.0995	19.4633	19.8473	20.1032	20.1587	20.1803	20.1780	20.1833	20.1740	20.0445	19.5931	19.0610
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0
16 / 9	14	28	22	0	0	0	0	0	0	0	0	31
MIT	20.7690	20.6492	20.7941	20.9309	20.9882	20.9991	20.9997	20.9996	20.9932	20.8659	20.4767	20.4685 (87)
Th 2	20.1411	20.1517	20.1517	20.1649	20.1675	20.1808	20.1782	20.1835	20.1782	20.1623	20.1596	20.1490 (88)
util rest of house	0.9907	0.9644	0.8728	0.6709	0.4832	0.3094	0.2538	0.2653	0.4509	0.7928	0.9650	0.9940 (89)
MIT 2	19.9335	19.8479	19.9679	20.1032	20.1587	20.1803	20.1780	20.1833	20.1740	20.0445	19.5931	19.6688 (90)
Living area fraction												0.1063 (91)
MIT	20.0223	19.9330	20.0558	20.1912	20.2469	20.2673	20.2654	20.2701	20.2611	20.1318	19.6870	19.7538 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0223	19.9330	20.0558	20.1912	20.2469	20.2673	20.2654	20.2701	20.2611	20.1318	19.6870	19.7538 (93)

## 8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9903	0.9620	0.8699	0.6722	0.4874	0.3139	0.2590	0.2706	0.4567	0.7911	0.9585	0.9931	(94)
Useful gains	2797.5135	3510.2040	4108.8475	4048.8757	3232.8875	2219.5864	1603.3023	1593.6809	2324.4745	3030.9983	2883.0695	2504.9506	(95)
Ext temp.	5.4000	5.9000	7.1000	8.9000	11.5000	14.2000	15.9000	15.9000	13.9000	11.2000	8.3000	5.7000	(96)
Heat loss rate W	5635.7560	5336.2412	4926.5941	4220.7969	3258.4410	2221.1063	1603.6866	1594.1475	2336.8387	3350.3671	4286.0004	5362.2616	(97)
Space heating kWh	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394	(98a)
Space heating requirement - total per year (kWh/year)												7463.5081	
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	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7463.5081	
Space heating per m2										(98c) / (4) =		18.0304	(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 %)														451.7181	(206)
Efficiency of main space heating system 2 (in %)														0.0000	(207)
Efficiency of secondary/supplementary heating system, %														0.0000	(208)
Space heating requirement	2111.6525	1227.0969	608.4035	123.7833	19.0118	0.0000	0.0000	0.0000	0.0000	237.6104	1010.1103	2125.8394		(98)	
Space heating efficiency (main heating system 1)	451.7181	451.7181	451.7181	451.7181	451.7181	0.0000	0.0000	0.0000	0.0000	451.7181	451.7181	451.7181		(210)	
Space heating fuel (main heating system)	467.4713	271.6510	134.6865	27.4028	4.2088	0.0000	0.0000	0.0000	0.0000	52.6015	223.6152	470.6120		(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(215)	
Water heating requirement	299.1745	264.2560	279.8463	243.8349	234.8830	210.0295	206.0662	215.1260	218.4657	245.5571	263.5034	295.6095		(64)	
Efficiency of water heater (217)m	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017	189.6017		(216)	
Fuel for water heating, kWh/month	157.7910	139.3743	147.5969	128.6037	123.8823	110.7741	108.6837	113.4621	115.2235	129.5121	138.9773	155.9108		(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	163.2773	147.4762	163.2773	158.0102	163.2773	158.0102	163.2773	163.2773	158.0102	163.2773	158.0102	163.2773		(231)	
Lighting	71.4608	57.3285	51.6179	37.8175	29.2113	23.8659	26.6476	34.6375	44.9907	59.0302	66.6745	73.4469		(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-239.3408	-314.1498	-468.3291	-554.3242	-597.7370	-592.3914	-550.3142	-540.7905	-476.3746	-376.8151	-266.0373	-201.5648		(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-9.8878	-23.8382	-65.4946	-133.8942	-182.8779	-216.5932	-176.6593	-165.5607	-115.4146	-50.7205	-17.4670	-6.9207		(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													1652.2491	(211)	
Space heating fuel - main system 2													0.0000	(213)	
Space heating fuel - secondary													0.0000	(215)	
Efficiency of water heater													189.6017		
Water heating fuel used													1569.7919	(219)	
Space cooling fuel													0.0000	(221)	
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5120) mechanical ventilation fans (SFP = 1.5120)													1922.4580	(230a)	
Total electricity for the above, kWh/year													1922.4580	(231)	
Electricity for lighting (calculated in Appendix L)													576.7293	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation													-6343.4977	(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													-622.2694	(238)	

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1652.2491	25.1600	415.7059	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1569.7919	25.1600	394.9596	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	1922.4580	25.1600	483.6904	(249)
Energy for lighting	576.7293	25.1600	145.1051	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-5178.1688	25.1600	-1302.8273	
PV Unit electricity exported	-1165.3288	5.8100	-67.7056	

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Total -1370.5329 (252)  
 Total energy cost 68.9282 (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	1652.2491	0.1588	262.3726 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1569.7919	0.1411	221.4794 (264)
Space and water heating			483.8521 (265)
Pumps, fans and electric keep-hot	1922.4580	0.1387	266.6686 (267)
Energy for lighting	576.7293	0.1443	83.2399 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-5178.1688	0.1341	-694.2322
PV Unit electricity exported	-1165.3288	0.1207	-140.6249
Total			-834.8571 (269)
Total CO2, kg/year			-1.0965 (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	1652.2491	1.5878	2623.3690 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1569.7919	1.5217	2388.7573 (278)
Space and water heating			5012.1263 (279)
Pumps, fans and electric keep-hot	1922.4580	1.5128	2908.2944 (281)
Energy for lighting	576.7293	1.5338	884.6067 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-5178.1688	1.4954	-7743.6644
PV Unit electricity exported	-1165.3288	0.4428	-516.0570
Total			-8259.7214 (283)
Total Primary energy kWh/year			545.3060 (286)