

Full SAP Calculation Printout



Property Reference	PENMELLYN-7121-23		Issued on Date	07/12/2023	
Assessment Reference	SEC1 - ASHP ROI TF 0.15 improv	Prop Type Ref	DS		
Property	Proposed dwelling, Westward Ho, Ashton, Helston, Cornwall, TR13 9SD				
SAP Rating	98 A	DER	-0.76	TER	10.58
Environmental	101 A	% DER < TER			107.18
CO ₂ Emissions (t/year)	-0.21	DFEE	38.78	TFEE	49.43
Compliance Check	See BREL	% DFEE < TFEE			21.55
% DPER < TPER	90.21	DPER	5.51	TPER	56.27
Assessor Details	Mr. Stuart Thomas			Assessor ID	V220-0003
Client	Penmellyn Design, Penmellyn Ltd				

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 ²)	Storey height (m)	Volume (m ³)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	305.7222 (5)

2. Ventilation rate

	m3 per hour											
Number of open chimneys	0 * 80 =											0.0000 (6a)
Number of open flues	0 * 20 =											0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)
Number of blocked chimneys	0 * 20 =											0.0000 (6f)
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)
Number of passive vents	0 * 10 =											0.0000 (7b)
Number of flueless gas fires	0 * 40 =											0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =											0.0000 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												0.9500 (17)
Infiltration rate												0.0475 (18)
Number of sides sheltered												2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.0404 (21)
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)
Door			2.1000	1.0000	2.1000		(26a)
5			1.1100	1.0536	1.1695		(27a)
10			1.1100	1.0536	1.1695		(27a)
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)
Total net area of external elements Aum(A, m ²)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.2825		(33)
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)

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Internal Floor 1	28.7700	18.0000	517.8600 (32d)
Internal Ceiling 1	28.7700	9.0000	258.9300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16323.1100 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 133.9387 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	16.6100	0.0300	0.4983
E5 Ground floor (normal)	41.0000	0.0210	0.8610
E11 Eaves (insulation at rafter level)	46.8100	0.0390	1.8256
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0150	-0.0398
R4 Ridge (vaulted ceiling)	6.5000	0.1200	0.7800
R7 Flat ceiling (inverted)	5.2200	0.1200	0.6264
E2 Other lintels (including other steel lintels)	13.7000	0.0840	1.1508
E3 Sill	12.7000	0.0430	0.5461
E4 Jamb	33.0000	0.0340	1.1220
R1 Head of roof window	1.8800	0.2400	0.4512
R2 Sill of roof window	1.8800	0.2400	0.4512
R3 Jamb of roof window	4.7200	0.2400	1.1328

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4056 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 85.6882 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	14.7779	14.6761	14.5743	14.0651	13.9633	13.4541	13.4541	13.3523	13.6578	13.9633	14.1669	14.3706 (38)
Heat transfer coeff	100.4661	100.3643	100.2624	99.7533	99.6514	99.1423	99.1423	99.0404	99.3459	99.6514	99.8551	100.0588 (39)
Average = Sum(39)m / 12 =												99.7278

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.8244	0.8235	0.8227	0.8185	0.8177	0.8135	0.8135	0.8127	0.8152	0.8177	0.8194	0.8210 (40)
HLP (average)												0.8183
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8703 (42)

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

Hot water usage for baths 83.4510 82.2116 80.4663 77.2483 74.8387 72.1669 70.7237 72.4568 74.3438 77.2027 80.4870 83.1689 (42b)

Hot water usage for other uses 44.0243 42.4234 40.8226 39.2217 37.6208 36.0199 36.0199 37.6208 39.2217 40.8226 42.4234 44.0243 (42c)

Average daily hot water use (litres/day) 117.3943 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932 (44)
Energy conte	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538 (45)
Energy content (annual)												Total = Sum(45)m = 1949.5019
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731 (46)
Water storage loss:												200.0000 (47)
Store volume												1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8640 (55)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002 (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	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002 (64)
Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 2538.7579 (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	107.1654	95.1742	102.0206	91.7599	90.3750	82.9775	82.9619	85.3565	85.3081	93.2901	96.9692	106.2557 (65)

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	149.3149	165.3129	149.3149	154.2920	149.3149	154.2920	149.3149	149.3149	154.2920	149.3149	154.2920	149.3149 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6280	290.6127	283.0914	267.0795	246.8673	227.8706	215.1797	212.1951	219.7164	235.7283	255.9405	274.9371 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513 (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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104 (71)
Water heating gains (Table 5)	144.0396	141.6283	137.1245	127.4444	121.4718	115.2465	111.5079	114.7265	118.4834	125.3899	134.6794	142.8169 (72)
Total internal gains	647.0364	663.6078	635.5846	614.8698	583.7078	563.4631	542.0564	542.2903	558.5457	576.4869	610.9658	633.1228 (73)

6. Solar gains

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[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		2.0700	10.6334	0.7600	0.7000	0.7700	8.1150 (74)
East		4.4400	19.6403	0.7600	0.7000	0.7700	32.1496 (76)
South		4.5500	46.7521	0.7600	0.7000	0.7700	78.4255 (78)
West		7.5600	19.6403	0.7600	0.7000	0.7700	54.7412 (80)
East		1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)
West		1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)

Solar gains	198.1584	365.2821	561.1908	778.1584	932.6495	948.8741	905.5434	789.3435	637.5321	421.4566	242.6989	165.9586 (83)
Total gains	845.1948	1028.8899	1196.7754	1393.0282	1516.3573	1512.3372	1447.5999	1331.6338	1196.0778	997.9435	853.6647	799.0813 (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	45.1316	45.1774	45.2233	45.4541	45.5006	45.7343	45.7343	45.7813	45.6405	45.5006	45.4078	45.3153
alpha	4.0088	4.0118	4.0149	4.0303	4.0334	4.0490	4.0490	4.0521	4.0427	4.0334	4.0272	4.0210
util living area	0.9672	0.9337	0.8701	0.7401	0.5756	0.4122	0.2997	0.3392	0.5457	0.8162	0.9405	0.9730 (86)
Living	19.9337	20.1694	20.4485	20.7205	20.8612	20.9110	20.9210	20.9193	20.8858	20.6677	20.2494	19.8831
Non living	18.9713	19.2661	19.6083	19.9299	20.0830	20.1344	20.1423	20.1421	20.1121	19.8790	19.3729	18.9099
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.4545	20.1694	20.4485	20.7205	20.8612	20.9110	20.9210	20.9193	20.8858	20.6677	20.2494	20.0394 (87)
Th 2	20.2323	20.2330	20.2337	20.2373	20.2380	20.2416	20.2416	20.2424	20.2402	20.2380	20.2366	20.2351 (88)
util rest of house	0.9620	0.9240	0.8525	0.7103	0.5358	0.3657	0.2487	0.2845	0.4930	0.7857	0.9300	0.9686 (89)
MIT 2	19.7295	19.2661	19.6083	19.9299	20.0830	20.1344	20.1423	20.1421	20.1121	19.8790	19.3729	19.1487 (90)
Living area fraction									FLA = Living area / (4) =			0.3161 (91)
MIT	19.9587	19.5516	19.8739	20.1798	20.3290	20.3799	20.3884	20.3877	20.3566	20.1283	19.6499	19.4302 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9587	19.5516	19.8739	20.1798	20.3290	20.3799	20.3884	20.3877	20.3566	20.1283	19.6499	19.4302 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9599	0.9140	0.8433	0.7080	0.5406	0.3742	0.2586	0.2951	0.5013	0.7809	0.9205	0.9631 (94)
Useful gains	811.2764	940.3627	1009.2822	986.2298	819.8096	565.9802	374.4133	392.9231	599.5865	779.3022	785.8240	769.5816 (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	1573.1667	1470.4951	1340.8953	1125.1994	859.8905	573.0281	375.5946	394.9452	621.5714	949.5086	1253.1733	1523.9181 (97)
Space heating kWh	566.8464	356.2490	246.7201	100.0581	29.8202	0.0000	0.0000	0.0000	0.0000	126.6336	336.4915	561.2264 (98a)
Space heating requirement - total per year (kWh/year)												2324.0452
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	566.8464	356.2490	246.7201	100.0581	29.8202	0.0000	0.0000	0.0000	0.0000	126.6336	336.4915	561.2264 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2324.0452
Space heating per m2										(98c) / (4) =		19.0699 (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 %)												374.9485 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	566.8464	356.2490	246.7201	100.0581	29.8202	0.0000	0.0000	0.0000	0.0000	126.6336	336.4915	561.2264 (98)
Space heating efficiency (main heating system 1)	374.9485	374.9485	374.9485	374.9485	374.9485	0.0000	0.0000	0.0000	0.0000	374.9485	374.9485	374.9485 (210)
Space heating fuel (main heating system)	151.1798	95.0128	65.8011	26.6858	7.9531	0.0000	0.0000	0.0000	0.0000	33.7736	89.7434	149.6809 (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	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002 (64)
Efficiency of water heater												200.5349 (216)
(217)m	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349 (217)
Fuel for water heating, kWh/month	125.6320	111.0439	117.9161	103.6596	100.4506	90.4881	89.3328	92.9242	93.9834	104.8225	111.4721	124.2677 (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	26.4827	23.9198	26.4827	25.6284	26.4827	25.6284	26.4827	25.6284	26.4827	25.6284	26.4827	26.4827 (231)
Lighting	28.8686	23.1595	20.8526	15.2775	11.8008	9.6413	10.7651	13.9928	18.1753	23.8470	26.9351	29.6710 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-67.8953	-96.1444	-137.9733	-152.4793	-162.5327	-150.6138	-148.7627	-140.7603	-125.2490	-107.4822	-74.1981	-58.5111 (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	-32.2777	-71.0155	-146.7192	-229.0647	-308.8329	-312.8136	-308.5404	-258.7877	-187.6772	-106.2096	-44.6215	-25.3166 (233b)

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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												619.8306	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												200.5349	
Water heating fuel used												1265.9930	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360) mechanical ventilation fans (SFP = 0.8360)												311.8122	(230a)
Total electricity for the above, kWh/year												311.8122	(231)
Electricity for lighting (calculated in Appendix L)												232.9865	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3454.4788	(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												-1023.8565	(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	619.8306	0.1570	97.3203	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1265.9930	0.1409	178.3608	(264)
Space and water heating			275.6811	(265)
Pumps, fans and electric keep-hot	311.8122	0.1387	43.2522	(267)
Energy for lighting	232.9865	0.1443	33.6272	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1422.6022	0.1348	-191.8095	
PV Unit electricity exported	-2031.8766	0.1249	-253.8226	
Total			-445.6321	(269)
Total CO2, kg/year			-93.0717	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.7600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	619.8306	1.5812	980.0811	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1265.9930	1.5209	1925.5055	(278)
Space and water heating			2905.5866	(279)
Pumps, fans and electric keep-hot	311.8122	1.5128	471.7095	(281)
Energy for lighting	232.9865	1.5338	357.3625	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1422.6022	1.4983	-2131.5236	
PV Unit electricity exported	-2031.8766	0.4585	-931.6388	
Total			-3063.1624	(283)
Total Primary energy kWh/year			671.4961	(286)
Dwelling Primary energy Rate (DPER)			5.5100	(287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)	
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)	
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 305.7222 (5)	

2. Ventilation rate

	m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)

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Number of flueless gas fires												0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												Air changes per hour	40.0000 / (5) =	0.1308 (8)
Pressure test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50												5.0000	(17)	
Infiltration rate												0.3808	(18)	
Number of sides sheltered												2	(19)	
Shelter factor												(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.3237 (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	0.4127	0.4046	0.3965	0.3561	0.3480	0.3075	0.3075	0.2994	0.3237	0.3480	0.3642	0.3804 (22b)
Effective ac	0.5852	0.5819	0.5786	0.5634	0.5605	0.5473	0.5473	0.5448	0.5524	0.5605	0.5663	0.5723 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type (Uw = 1.20)			18.6200	1.1450	21.3206		(27)
5			1.1100	1.5918	1.7669		(27a)
10			1.1100	1.5918	1.7669		(27a)
Floor 1 P/a 0.44			93.1000	0.1300	12.1030		(28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1800	31.1292		(29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1800	0.7614		(29a)
External Wall 3 Attic	44.8500		44.8500	0.1800	8.0730		(29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1100	3.8874		(30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.1100	7.0763		(30)
Total net area of external elements Aum(A, m2)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	89.9846	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 133.9387 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	16.6100	0.0900	1.4949
E5 Ground floor (normal)	41.0000	0.1600	6.5600
E11 Eaves (insulation at rafter level)	46.8100	0.0400	1.8724
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0900	-0.2385
R4 Ridge (vaulted ceiling)	6.5000	0.0800	0.5200
R7 Flat ceiling (inverted)	5.2200	0.0400	0.2088
E2 Other lintels (including other steel lintels)	13.7000	0.0500	0.6850
E3 Sill	12.7000	0.0500	0.6350
E4 Jamb	33.0000	0.0500	1.6500
R1 Head of roof window	1.8800	0.0800	0.1504
R2 Sill of roof window	1.8800	0.0600	0.1128
R3 Jamb of roof window	4.7200	0.0800	0.3776

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.0284 (36)

Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 104.0130 (37)

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

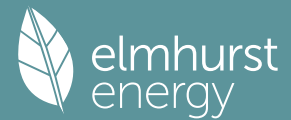
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	59.0372	58.7036	58.3765	56.8402	56.5528	55.2148	55.2148	54.9670	55.7302	56.5528	57.1343	57.7422 (38)
Heat transfer coeff	163.0503	162.7166	162.3895	160.8533	160.5658	159.2278	159.2278	158.9800	159.7432	160.5658	161.1473	161.7552 (39)
Average = Sum(39)m / 12 =												160.8519

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3379	1.3352	1.3325	1.3199	1.3175	1.3065	1.3065	1.3045	1.3108	1.3175	1.3223	1.3273 (40)
HLP (average)												1.3199
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8703 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	83.4510	82.2116	80.4663	77.2483	74.8387	72.1669	70.7237	72.4568	74.3438	77.2027	80.4870	83.1689 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243 (42c)
Average daily hot water use (litres/day)												117.3943 (43)
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932 (44)
Energy conte	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538 (45)
Energy content (annual)												Total = Sum(45)m = 1949.5019
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731 (46)
Water storage loss:												200.0000 (47)
Store volume												1.6525 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8924 (55)
Enter (49) or (54) in (55)												
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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	252.8158	223.4764	237.3426	208.7249	202.3182	182.3116	180.0232	187.2251	189.3208	211.0853	224.3917	250.0798 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

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Output from w/h	252.8158	223.4764	237.3426	208.7249	202.3182	182.3116	180.0232	187.2251	189.3208	211.0853	224.3917	250.0798 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2549.1154 (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	107.8692	95.8098	102.7243	92.4410	91.0787	83.6585	83.6656	86.0603	85.9891	93.9938	97.6502	106.9595 (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	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.9040	164.8581	148.9040	153.8675	148.9040	153.8675	148.9040	148.9040	153.8675	148.9040	153.8675	148.9040 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6280	290.6127	283.0914	267.0795	246.8673	227.8706	215.1797	212.1951	219.7164	235.7283	255.9405	274.9371 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513 (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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104 (71)
Water heating gains (Table 5)	144.9855	142.5742	138.0704	128.3902	122.4177	116.1924	112.4538	115.6724	119.4293	126.3357	135.6253	143.7628 (72)
Total internal gains	650.5714	667.0988	639.1197	618.3911	587.2429	563.9845	542.5915	542.8254	559.0671	580.0220	614.4872	636.6578 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	2.0700	10.6334	0.6300	0.7000	0.7700	6.7269 (74)						
East	4.4400	19.6403	0.6300	0.7000	0.7700	26.6503 (76)						
South	4.5500	46.7521	0.6300	0.7000	0.7700	65.0106 (78)						
West	7.5600	19.6403	0.6300	0.7000	0.7700	45.3775 (80)						
East	1.1100	26.0000	0.6300	0.7000	1.0000	11.4545 (82)						
West	1.1100	26.0000	0.6300	0.7000	1.0000	11.4545 (82)						
Solar gains	166.6744	307.8081	474.1015	658.9648	790.9252	805.1166	768.1775	668.8859	539.1467	355.4868	204.2453	139.5187 (83)
Total gains	817.2458	974.9069	1113.2212	1277.3559	1378.1681	1369.1010	1310.7690	1211.7113	1098.2138	935.5087	818.7325	776.1765 (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	27.8086	27.8656	27.9217	28.1884	28.2389	28.4762	28.4762	28.5205	28.3843	28.2389	28.1370	28.0312
alpha	2.8539	2.8577	2.8614	2.8792	2.8826	2.8984	2.8984	2.9014	2.8923	2.8826	2.8758	2.8687
util living area	0.9772	0.9619	0.9346	0.8730	0.7714	0.6261	0.4902	0.5393	0.7444	0.9075	0.9642	0.9802 (86)
MIT	18.4632	18.7810	19.2648	19.8988	20.4298	20.7847	20.9227	20.8964	20.6219	19.9117	19.0795	18.4130 (87)
Th 2	19.8113	19.8134	19.8155	19.8253	19.8271	19.8357	19.8357	19.8373	19.8324	19.8271	19.8234	19.8195 (88)
util rest of house	0.9727	0.9545	0.9214	0.8464	0.7218	0.5428	0.3767	0.4253	0.6723	0.8823	0.9559	0.9763 (89)
MIT 2	16.8777	17.2806	17.8899	18.6758	19.2996	19.6813	19.7991	19.7841	19.5300	18.7110	17.6697	16.8187 (90)
Living area fraction	FLA = Living area / (4) =											0.3161 (91)
MIT	17.3788	17.7548	18.3245	19.0624	19.6568	20.0301	20.1543	20.1357	19.8752	19.0905	18.1153	17.3226 (92)
Temperature adjustment												0.0000
adjusted MIT	17.3788	17.7548	18.3245	19.0624	19.6568	20.0301	20.1543	20.1357	19.8752	19.0905	18.1153	17.3226 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9590	0.9364	0.8994	0.8255	0.7137	0.5578	0.4094	0.4565	0.6753	0.8621	0.9388	0.9639 (94)	
Ext temp.	783.7779	912.8952	1001.2672	1054.4992	983.5731	763.7238	536.6396	553.1221	741.5915	806.4555	768.5855	748.1337 (95)	
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)	
Space heating kWh	2132.5044	2091.6960	1920.1699	1634.6505	1277.5934	864.6152	565.9377	593.8988	922.5416	1363.2826	1775.0871	2122.6563 (97)	
Space heating requirement - total per year (kWh/year)	1003.4525	792.1542	683.6637	417.7089	218.7511	0.0000	0.0000	0.0000	0.0000	414.2794	724.6812	1022.6448 (98a)	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)	
Space heating contribution - total per year (kWh/year)	1003.4525	792.1542	683.6637	417.7089	218.7511	0.0000	0.0000	0.0000	0.0000	414.2794	724.6812	1022.6448 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												5277.3358	
Space heating per m2												(98c) / (4) =	43.3030 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Space heating efficiency (main heating system 1)	1003.4525	792.1542	683.6637	417.7089	218.7511	0.0000	0.0000	0.0000	0.0000	414.2794	724.6812	1022.6448	(98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	1087.1642	858.2385	740.6974	452.5557	237.0001	0.0000	0.0000	0.0000	0.0000	448.8401	785.1367	1107.9576	(211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	252.8158	223.4764	237.3426	208.7249	202.3182	182.3116	180.0232	187.2251	189.3208	211.0853	224.3917	250.0798	(64)
Efficiency of water heater (217)m	86.8293	86.6497	86.2920	85.5839	84.2353	79.8000	79.8000	79.8000	79.8000	85.5435	86.4936	79.8000	(216)
Fuel for water heating, kWh/month	291.1642	257.9079	275.0458	243.8834	240.1823	228.4606	225.5930	234.6179	237.2441	246.7578	259.4316	287.8624	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	30.9393	24.8207	22.3483	16.3733	12.6472	10.3329	11.5372	14.9965	19.4790	25.5575	28.8671	31.7992	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-73.9593	-98.2219	-133.0619	-140.6821	-144.5156	-132.3034	-130.5214	-126.5235	-118.7278	-107.7343	-79.0620	-64.6634	(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	-62.3574	-128.1084	-249.2430	-366.9019	-478.2624	-478.1843	-472.6630	-403.3813	-299.9042	-180.7525	-82.4065	-49.5591	(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													5717.5902 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													79.8000
Water heating fuel used													3028.1510 (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)													249.6980 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4601.7008 (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													4479.7385 (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	5717.5902	0.2100	1200.6939 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3028.1510	0.2100	635.9117 (264)
Space and water heating			1836.6057 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	249.6980	0.1443	36.0391 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1349.9767	0.1359	-183.4730
PV Unit electricity exported	-3251.7241	0.1265	-411.3222
Total			-594.7952 (269)
Total CO2, kg/year			1289.7789 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.5800 (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	5717.5902	1.1300	6460.8770 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3028.1510	1.1300	3421.8106 (278)
Space and water heating			9882.6876 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	249.6980	1.5338	382.9952 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1349.9767	1.5024	-2028.1595
PV Unit electricity exported	-3251.7241	0.4643	-1509.9202
Total			-3538.0797 (283)
Total Primary energy kWh/year			6857.7038 (286)
Target Primary Energy Rate (TPER)			56.2700 (287)

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1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 305.7222 (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) = 40.0000 / (5) = 0.1308 (8)											
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50	0.9500 (17)											
Infiltration rate	0.1783 (18)											
Number of sides sheltered	2 (19)											
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)											
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1516 (21)											
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.1933	0.1895	0.1857	0.1667	0.1630	0.1440	0.1440	0.1402	0.1516	0.1630	0.1705	0.1781 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000 (23b)											
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000 (23c)											
Effective ac	0.5187	0.5180	0.5172	0.5139	0.5133	0.5104	0.5104	0.5098	0.5115	0.5133	0.5145	0.5159 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K					
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)					
Door			2.1000	1.0000	2.1000		(26a)					
5			1.1100	1.0536	1.1695		(27a)					
10			1.1100	1.0536	1.1695		(27a)					
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)					
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)					
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)					
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)					
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)					
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)					
Total net area of external elements Aum(A, m ²)			437.7300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.2825		(33)					
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)					
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)					
Internal Floor 1			28.7700			18.0000	517.8600 (32d)					
Internal Ceiling 1			28.7700			9.0000	258.9300 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 16323.1100 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							133.9387 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E16 Corner (normal)				16.6100	0.0300	0.4983						
E5 Ground floor (normal)				41.0000	0.0210	0.8610						
E11 Eaves (insulation at rafter level)				46.8100	0.0390	1.8256						
E17 Corner (inverted - internal area greater than external area)				2.6500	-0.0150	-0.0398						
R4 Ridge (vaulted ceiling)				6.5000	0.1200	0.7800						
R7 Flat ceiling (inverted)				5.2200	0.1200	0.6264						
E2 Other lintels (including other steel lintels)				13.7000	0.0840	1.1508						
E3 Sill				12.7000	0.0430	0.5461						
E4 Jamb				33.0000	0.0340	1.1220						
R1 Head of roof window				1.8800	0.2400	0.4512						
R2 Sill of roof window				1.8800	0.2400	0.4512						
R3 Jamb of roof window				4.7200	0.2400	1.1328						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.4056 (36)					
Point Thermal bridges							(36a) = 0.0000					
Total fabric heat loss							(33) + (36) + (36a) = 85.6882 (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	52.3285	52.2553	52.1836	51.8467	51.7837	51.4903	51.4903	51.4360	51.6033	51.7837	51.9112	52.0445 (38)
Average = Sum(39)m / 12 =	138.0167	137.9435	137.8718	137.5349	137.4719	137.1785	137.1785	137.1241	137.2915	137.4719	137.5994	137.7327 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1325	1.1319	1.1313	1.1285	1.1280	1.1256	1.1256	1.1252	1.1265	1.1280	1.1291	1.1302 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8703 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												31.2338 (42b)
Hot water usage for other uses												44.0243 (42c)
Average daily hot water use (litres/day)												68.9807 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	75.2581	73.1934	70.9392	68.1339	65.6312	63.0303	62.4901	64.7397	67.0468	69.7178	72.5479	75.1525 (44)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Total heat required for water heating calculated for each month	101.3119	88.5924	92.6763	79.2812	75.0994	65.8776	64.2400	68.1371	70.2741	80.4154	87.8541	100.0201 (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	101.3119	88.5924	92.6763	79.2812	75.0994	65.8776	64.2400	68.1371	70.2741	80.4154	87.8541	100.0201 (64)
12Total per year (kWh/year)												973.7795 (64)
Electric shower(s)												974 (64)
Heat gains from water heating, kWh/month	39.8120	35.0535	37.2612	33.2683	32.4752	29.5382	29.5644	30.7346	31.0165	34.1960	35.7907	39.4890 (65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a) m =												659.0185 (64a)

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	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	149.3149	165.3129	149.3149	154.2920	149.3149	154.2920	149.3149	149.3149	154.2920	149.3149	154.2920	149.3149 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6280	290.6127	283.0914	267.0795	246.8673	227.8706	215.1797	212.1951	219.7164	235.7283	255.9405	274.9371 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513 (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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104 (71)
Water heating gains (Table 5)	53.5107	52.1629	50.0823	46.2059	43.6494	41.0253	39.7371	41.3099	43.0785	45.9624	49.7093	53.0766 (72)
Total internal gains	556.5075	574.1424	548.5425	533.6313	505.8854	489.2418	470.2856	468.8737	483.1408	497.0594	525.9957	543.3825 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	2.0700	10.6334	0.7600	0.7000	0.7700	8.1150 (74)						
East	4.4400	19.6403	0.7600	0.7000	0.7700	32.1496 (76)						
South	4.5500	46.7521	0.7600	0.7000	0.7700	78.4255 (78)						
West	7.5600	19.6403	0.7600	0.7000	0.7700	54.7412 (80)						
East	1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)						
West	1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)						
Solar gains	198.1584	365.2821	561.1908	778.1584	932.6495	948.8741	905.5434	789.3435	637.5321	421.4566	242.6989	165.9586 (83)
Total gains	754.6659	939.4245	1109.7333	1311.7897	1438.5349	1438.1160	1375.8290	1258.2173	1120.6728	918.5160	768.6946	709.3411 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.8525	32.8700	32.8871	32.9676	32.9827	33.0533	33.0533	33.0664	33.0261	32.9827	32.9522	32.9203
alpha	3.1902	3.1913	3.1925	3.1978	3.1988	3.2036	3.2036	3.2044	3.2017	3.1988	3.1968	3.1947
util living area	0.9807	0.9619	0.9258	0.8434	0.7151	0.5545	0.4206	0.4724	0.6946	0.8971	0.9668	0.9840 (86)
MIT	18.8146	19.1600	19.6423	20.2200	20.6508	20.8874	20.9651	20.9490	20.7636	20.1530	19.3651	18.7417 (87)
Th 2	19.9744	19.9749	19.9754	19.9776	19.9780	19.9800	19.9800	19.9803	19.9792	19.9780	19.9772	19.9763 (88)
util rest of house	0.9771	0.9550	0.9122	0.8154	0.6664	0.4818	0.3301	0.3783	0.6261	0.8719	0.9596	0.9810 (89)
MIT 2	17.9829	18.3233	18.7939	19.3428	19.7271	19.9168	19.9666	19.9594	19.8315	19.2951	18.5312	17.9120 (90)
Living area fraction												fLA = Living area / (4) = 0.3161 (91)
MIT	18.2458	18.5877	19.0621	19.6201	20.0191	20.2236	20.2822	20.2722	20.1262	19.5663	18.7948	18.1742 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2458	18.5877	19.0621	19.6201	20.0191	20.2236	20.2822	20.2722	20.1262	19.5663	18.7948	18.1742 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9687	0.9428	0.8974	0.8042	0.6685	0.4999	0.3576	0.4062	0.6368	0.8598	0.9485	0.9736	(94)
Useful gains	731.0563	885.6748	995.8503	1054.9867	961.6287	718.9823	492.0254	511.1083	713.6032	789.7050	729.0690	690.5947	(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	1924.7494	1888.1357	1731.9568	1474.3853	1143.6385	771.4356	505.1202	530.9716	827.3403	1232.6123	1609.1981	1924.7088	(97)
Space heating kWh	888.1076	673.6537	547.6632	301.9670	135.4153	0.0000	0.0000	0.0000	0.0000	329.5230	633.6929	918.1809	(98a)
Space heating requirement - total per year (kWh/year)												4428.2038	
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	888.1076	673.6537	547.6632	301.9670	135.4153	0.0000	0.0000	0.0000	0.0000	329.5230	633.6929	918.1809	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4428.2038	
Space heating per m2											(98c) / (4) =	36.3355	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1289.4774	1015.1205	1042.1433	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8337	0.8877	0.8576	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1075.0949	901.1510	893.7512	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1583.6525	1515.5948	1386.2656	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	366.1615	457.1462	366.4307	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fc = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	91.5404	114.2866	91.6077	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												297.4346	(107)
Energy for space heating												36.3355	(99)
Energy for space cooling												2.4406	(108)
Total												38.7761	(109)
Fabric Energy Efficiency (DFEE)												38.8	(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	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)	
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	305.7222 (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)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1308	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3808	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3237	(21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000		(22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750		(22a)
Adj infilt rate	0.4127 0.4046 0.3965 0.3561 0.3480 0.3075 0.3075 0.2994 0.3237 0.3480 0.3642 0.3804		(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		0.0000	(23c)
Effective ac	0.5852 0.5819 0.5786 0.5634 0.5605 0.5473 0.5473 0.5448 0.5524 0.5605 0.5663 0.5723		(25)

Full SAP Calculation Printout



3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
TER Semi-glazed door			2.1000	1.0000	2.1000			(26a)
TER Opening Type (Uw = 1.20)			18.6200	1.1450	21.3206			(27)
5			1.1100	1.5918	1.7669			(27a)
10			1.1100	1.5918	1.7669			(27a)
Floor 1 P/a 0.44			93.1000	0.1300	12.1030			(28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1800	31.1292			(29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1800	0.7614			(29a)
External Wall 3 Attic	44.8500		44.8500	0.1800	8.0730			(29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1100	3.8874			(30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.1100	7.0763			(30)
Total net area of external elements Aum(A, m ²)			437.7300					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	89.9846		(33)

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

133.9387 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	16.6100	0.0900	1.4949
E5 Ground floor (normal)	41.0000	0.1600	6.5600
E11 Eaves (insulation at rafter level)	46.8100	0.0400	1.8724
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0900	-0.2385
R4 Ridge (vaulted ceiling)	6.5000	0.0800	0.5200
R7 Flat ceiling (inverted)	5.2200	0.0400	0.2088
E2 Other lintels (including other steel lintels)	13.7000	0.0500	0.6850
E3 Sill	12.7000	0.0500	0.6350
E4 Jamb	33.0000	0.0500	1.6500
R1 Head of roof window	1.8800	0.0800	0.1504
R2 Sill of roof window	1.8800	0.0600	0.1128
R3 Jamb of roof window	4.7200	0.0800	0.3776

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

14.0284 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 104.0130 (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	59.0372	58.7036	58.3765	56.8402	56.5528	55.2148	55.2148	54.9670	55.7302	56.5528	57.1343	57.7422
Average = Sum(39)m / 12 =	163.0503	162.7166	162.3895	160.8533	160.5658	159.2278	159.2278	158.9800	159.7432	160.5658	161.1473	161.7552

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3379	1.3352	1.3325	1.3199	1.3175	1.3065	1.3065	1.3045	1.3108	1.3175	1.3223	1.3273
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8703 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	31.2338	30.7699	30.1167	28.9123	28.0104	27.0104	26.4702	27.1189	27.8252	28.8952	30.1244	31.1282	31.1282 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243	44.0243 (42c)
Average daily hot water use (litres/day)													68.9807 (43)
Daily hot water use	75.2581	73.1934	70.9392	68.1339	65.6312	63.0303	62.4901	64.7397	67.0468	69.7178	72.5479	75.1525	75.1525 (44)
Energy content (annual)	119.1904	104.2264	109.0310	93.2720	88.3522	77.5031	75.5764	80.1612	82.6754	94.6063	103.3577	117.6707	117.6707 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Total heat required for water heating calculated for each month	101.3119	88.5924	92.6763	79.2812	75.0994	65.8776	64.2400	68.1371	70.2741	80.4154	87.8541	100.0201	100.0201 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	101.3119	88.5924	92.6763	79.2812	75.0994	65.8776	64.2400	68.1371	70.2741	80.4154	87.8541	100.0201	100.0201 (64)
12Total per year (kWh/year)													973.7795 (64)
Electric shower(s)	57.9360	51.6214	56.3686	53.7919	54.8013	52.2751	54.0176	54.8013	53.7919	56.3686	55.3087	57.9360	57.9360 (64a)
Heat gains from water heating, kWh/month	39.8120	35.0535	37.2612	33.2683	32.4752	29.5382	29.5644	30.7346	31.0165	34.1960	35.7907	39.4890	39.4890 (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	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129	143.5129
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.9040	164.8581	148.9040	153.8675	148.9040	153.8675	148.9040	148.9040	153.8675	148.9040	153.8675	148.9040
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6280	290.6127	283.0914	267.0795	246.8673	227.8706	215.1797	212.1951	219.7164	235.7283	255.9405	274.9371
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513	37.3513
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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104

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Water heating gains (Table 5)	53.5107	52.1629	50.0823	46.2059	43.6494	41.0253	39.7371	41.3099	43.0785	45.9624	49.7093	53.0766 (72)
Total internal gains	556.0967	573.6875	548.1317	533.2068	505.4746	488.8173	469.8748	468.4629	482.7162	496.6486	525.5712	542.9717 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
North	2.0700	10.6334	0.6300	0.6300	0.7000	0.7700	6.7269 (74)	
East	4.4400	19.6403	0.6300	0.6300	0.7000	0.7700	26.6503 (76)	
South	4.5500	46.7521	0.6300	0.6300	0.7000	0.7700	65.0106 (78)	
West	7.5600	19.6403	0.6300	0.6300	0.7000	0.7700	45.3775 (80)	
East	1.1100	26.0000	0.6300	0.6300	0.7000	1.0000	11.4545 (82)	
West	1.1100	26.0000	0.6300	0.6300	0.7000	1.0000	11.4545 (82)	

Solar gains	166.6744	307.8081	474.1015	658.9648	790.9252	805.1166	768.1775	668.8859	539.1467	355.4868	204.2453	139.5187 (83)
Total gains	722.7710	881.4956	1022.2332	1192.1716	1296.3998	1293.9339	1238.0522	1137.3488	1021.8629	852.1354	729.8165	682.4903 (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	27.8086	27.8656	27.9217	28.1884	28.2389	28.4762	28.4762	28.5205	28.3843	28.2389	28.1370	28.0312
alpha	2.8539	2.8577	2.8614	2.8792	2.8826	2.8984	2.8984	2.9014	2.8923	2.8826	2.8758	2.8687
util living area	0.9832	0.9700	0.9459	0.8889	0.7924	0.6494	0.5130	0.5654	0.7705	0.9240	0.9728	0.9857 (86)
MIT	18.3472	18.6719	19.1678	19.8255	20.3822	20.7622	20.9129	20.8826	20.5818	19.8301	18.9744	18.2966 (87)
Th 2	19.8113	19.8134	19.8155	19.8253	19.8271	19.8357	19.8357	19.8373	19.8324	19.8271	19.8234	19.8195 (88)
util rest of house	0.9798	0.9640	0.9346	0.8648	0.7449	0.5661	0.3964	0.4489	0.7010	0.9023	0.9664	0.9828 (89)
MIT 2	17.4107	17.7330	18.2220	18.8629	19.3773	19.7012	19.8031	19.7895	19.5677	18.8824	18.0426	17.3659 (90)
Living area fraction	FLA = Living area / (4) =											0.3161 (91)
MIT	17.7067	18.0298	18.5209	19.1671	19.6949	20.0366	20.1539	20.1350	19.8882	19.1819	18.3371	17.6601 (92)
Temperature adjustment												0.0000
adjusted MIT	17.7067	18.0298	18.5209	19.1671	19.6949	20.0366	20.1539	20.1350	19.8882	19.1819	18.3371	17.6601 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9712	0.9516	0.9185	0.8483	0.7388	0.5817	0.4301	0.4810	0.7049	0.8870	0.9549	0.9751 (94)
Useful gains	701.9216	838.8408	938.8988	1011.3702	957.7527	752.7155	532.5378	547.0316	720.2620	755.8765	696.9153	665.4935 (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	2185.9677	2136.4341	1952.0753	1651.5036	1283.7153	865.6506	565.8796	593.7934	924.6253	1377.9644	1810.8327	2177.2360 (97)
Space heating kWh	1104.1303	871.9827	753.8033	460.8961	242.5162	0.0000	0.0000	0.0000	0.0000	462.8334	802.0206	1124.7364 (98a)
Space heating requirement - total per year (kWh/year)												5822.9190
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	1104.1303	871.9827	753.8033	460.8961	242.5162	0.0000	0.0000	0.0000	0.0000	462.8334	802.0206	1124.7364 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5822.9190
Space heating per m2												(98c) / (4) = 47.7798 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1496.7414	1178.2858	1208.2482	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7231	0.7935	0.7554	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1082.2227	934.9220	912.6844	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1417.9495	1357.2297	1247.2741	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	241.7233	314.1970	248.9347	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	60.4308	78.5492	62.2337	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												201.2137 (107)
Energy for space heating												47.7798 (99)
Energy for space cooling												1.6511 (108)
Total												49.4308 (109)
Fabric Energy Efficiency (TFEE)												49.4 (109)

Full SAP Calculation Printout



1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 305.7222 (5)

2. Ventilation rate

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		0.9500	(17)
Infiltration rate		0.0475	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.0404 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)
Door			2.1000	1.0000	2.1000		(26a)
5			1.1100	1.0536	1.1695		(27a)
10			1.1100	1.0536	1.1695		(27a)
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)
Total net area of external elements Aum(A, m ²)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.2825		(33)
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)
Internal Floor 1			28.7700			18.0000	517.8600 (32d)
Internal Ceiling 1			28.7700			9.0000	258.9300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	16323.1100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							133.9387 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	16.6100	0.0300	0.4983
E5 Ground floor (normal)	41.0000	0.0210	0.8610
E11 Eaves (insulation at rafter level)	46.8100	0.0390	1.8256
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0150	-0.0398
R4 Ridge (vaulted ceiling)	6.5000	0.1200	0.7800
R7 Flat ceiling (inverted)	5.2200	0.1200	0.6264
E2 Other lintels (including other steel lintels)	13.7000	0.0840	1.1508
E3 Sill	12.7000	0.0430	0.5461
E4 Jamb	33.0000	0.0340	1.1220
R1 Head of roof window	1.8800	0.2400	0.4512
R2 Sill of roof window	1.8800	0.2400	0.4512
R3 Jamb of roof window	4.7200	0.2400	1.1328

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.4056 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =		85.6882 (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	14.7779	14.6761	14.5743	14.0651	13.9633	13.4541	13.4541	13.3523	13.6578	13.9633	14.1669	14.3706 (38)
Heat transfer coeff	100.4661	100.3643	100.2624	99.7533	99.6514	99.1423	99.1423	99.0404	99.3459	99.6514	99.8551	100.0588 (39)
Average = Sum(39)m / 12 =												99.7278
HLP	0.8244	0.8235	0.8227	0.8185	0.8177	0.8135	0.8135	0.8127	0.8152	0.8177	0.8194	0.8210 (40)
HLP (average)												0.8183
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.8703 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	83.4510	82.2116	80.4663	77.2483	74.8387	72.1669	70.7237	72.4568	74.3438	77.2027	80.4870	83.1689	83.1689 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243	44.0243 (42c)
Average daily hot water use (litres/day)													117.3943 (43)
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932	(44)
Energy content (annual)	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538	(45)
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002	(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	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains from water heating, kWh/month	107.1654	95.1742	102.0206	91.7599	90.3750	82.9775	82.9619	85.3565	85.3081	93.2901	96.9692	106.2557	(65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a) m =													0.0000 (64a)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.9816	29.2940	23.8235	18.0359	13.4821	11.3821	12.2988	15.9864	21.4569	27.2445	31.7984	33.8983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.2956	433.7503	422.5245	398.6261	368.4586	340.1054	321.1638	316.7090	327.9349	351.8333	382.0008	410.3539	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	(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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	(71)
Water heating gains (Table 5)	144.0396	141.6283	137.1245	127.4444	121.4718	115.2465	111.5079	114.7265	118.4834	125.3899	134.6794	142.8169	(72)
Total internal gains	718.8138	717.1696	695.9695	656.6033	615.9094	579.2311	557.4675	559.9190	580.3722	616.9647	660.9755	699.5661	(73)

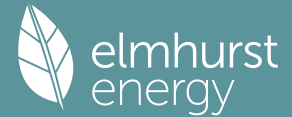
6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
North	2.0700	10.6334	0.7600	0.7000	0.7700	8.1150 (74)							
East	4.4400	19.6403	0.7600	0.7000	0.7700	32.1496 (76)							
South	4.5500	46.7521	0.7600	0.7000	0.7700	78.4255 (78)							
West	7.5600	19.6403	0.7600	0.7000	0.7700	54.7412 (80)							
East	1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)							
West	1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)							
Solar gains	198.1584	365.2821	561.1908	778.1584	932.6495	948.8741	905.5434	789.3435	637.5321	421.4566	242.6989	165.9586	(83)
Total gains	916.9722	1082.4517	1257.1602	1434.7618	1548.5589	1528.1052	1463.0109	1349.2625	1217.9043	1038.4212	903.6744	865.5247	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	45.1316	45.1774	45.2233	45.4541	45.5006	45.7343	45.7343	45.7813	45.6405	45.5006	45.4078	45.3153	
alpha	4.0088	4.0118	4.0149	4.0303	4.0334	4.0490	4.0490	4.0521	4.0427	4.0334	4.0272	4.0210	
util living area	0.9577	0.9236	0.8542	0.7267	0.5657	0.4082	0.2966	0.3349	0.5373	0.8005	0.9299	0.9651	(86)
Living	20.0035	20.2143	20.4859	20.7340	20.8650	20.9114	20.9211	20.9195	20.8878	20.6871	20.2926	19.9497	
Non living	19.0586	19.3211	19.6524	19.9446	20.0865	20.1347	20.1424	20.1422	20.1138	19.9002	19.4256	18.9936	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.4902	20.2143	20.4859	20.7340	20.8650	20.9114	20.9211	20.9195	20.8878	20.6871	20.2926	20.0967	(87)
Th 2	20.2323	20.2330	20.2337	20.2373	20.2380	20.2416	20.2416	20.2424	20.2402	20.2380	20.2366	20.2351	(88)
util rest of house	0.9512	0.9127	0.8353	0.6966	0.5262	0.3620	0.2461	0.2808	0.4851	0.7689	0.9180	0.9597	(89)
MIT 2	19.7644	19.3211	19.6524	19.9446	20.0865	20.1347	20.1424	20.1422	20.1138	19.9002	19.4256	19.2173	(90)
Living area fraction										fLA = Living area / (4) =			0.3161 (91)

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MIT	19.9938	19.6034	19.9159	20.1941	20.3326	20.3802	20.3885	20.3879	20.3584	20.1489	19.6997	19.4952 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9938	19.6034	19.9159	20.1941	20.3326	20.3802	20.3885	20.3879	20.3584	20.1489	19.6997	19.4952 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9490	0.9025	0.8267	0.6948	0.5312	0.3706	0.2560	0.2913	0.4934	0.7649	0.9083	0.9534 (94)
Useful gains	870.1886	976.9241	1039.2973	996.8425	822.5888	566.2647	374.4657	393.0319	600.9626	794.2673	820.8218	825.2106 (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	1576.6942	1475.6998	1345.1058	1126.6229	860.2488	573.0646	375.6016	394.9596	621.7494	951.5647	1258.1396	1530.4222 (97)
Space heating kWh	525.6402	335.1772	227.5216	93.4419	28.0191	0.0000	0.0000	0.0000	0.0000	117.0293	314.8688	524.6775 (98a)
Space heating requirement - total per year (kWh/year)												2166.3755
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	525.6402	335.1772	227.5216	93.4419	28.0191	0.0000	0.0000	0.0000	0.0000	117.0293	314.8688	524.6775 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2166.3755
Space heating per m2										(98c) / (4) =		17.7761 (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 %)												374.9485 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	525.6402	335.1772	227.5216	93.4419	28.0191	0.0000	0.0000	0.0000	0.0000	117.0293	314.8688	524.6775 (98)
Space heating efficiency (main heating system 1)	374.9485	374.9485	374.9485	374.9485	374.9485	0.0000	0.0000	0.0000	0.0000	374.9485	374.9485	374.9485 (210)
Space heating fuel (main heating system)	140.1900	89.3929	60.6808	24.9213	7.4728	0.0000	0.0000	0.0000	0.0000	31.2121	83.9766	139.9332 (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	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002 (64)
Efficiency of water heater (217)m	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349 (216)
Fuel for water heating, kWh/month	125.6320	111.0439	117.9161	103.6596	100.4506	90.4881	89.3328	92.9242	93.9834	104.8225	111.4721	124.2677 (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	26.4827	23.9198	26.4827	25.6284	26.4827	25.6284	26.4827	26.4827	25.6284	26.4827	25.6284	26.4827 (231)
Lighting	28.8686	23.1595	20.8526	15.2775	11.8008	9.6413	10.7651	13.9928	18.1753	23.8470	26.9351	29.6710 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-67.6716	-95.8707	-137.5073	-152.2140	-162.4359	-150.6138	-148.7627	-140.7603	-125.2490	-107.2755	-74.0085	-58.3493 (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	-32.5014	-71.2893	-147.1853	-229.3301	-308.9296	-312.8136	-308.5404	-258.7877	-187.6772	-106.4163	-44.8111	-25.4784 (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												577.7795 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												200.5349
Water heating fuel used												1265.9930 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)												
mechanical ventilation fans (SFP = 0.8360)												311.8122 (230a)
Total electricity for the above, kWh/year												311.8122 (231)
Electricity for lighting (calculated in Appendix L)												232.9865 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-3454.4788 (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												-1065.9075 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	577.7795	16.4900	95.2758 (240)
Total CO2 associated with community systems			0.0000 (473)

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Water heating (other fuel)	1265.9930	16.4900	208.7623 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	311.8122	16.4900	51.4178 (249)
Energy for lighting	232.9865	16.4900	38.4195 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1420.7185	16.4900	-234.2765
PV Unit electricity exported	-2033.7603	5.5900	-113.6872
Total			-347.9637 (252)
Total energy cost			45.9117 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.0990 (257)
SAP value		98.3944
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	577.7795	0.1570	90.7226 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1265.9930	0.1409	178.3608 (264)
Space and water heating			269.0833 (265)
Pumps, fans and electric keep-hot	311.8122	0.1387	43.2522 (267)
Energy for lighting	232.9865	0.1443	33.6272 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1420.7185	0.1348	-191.5241
PV Unit electricity exported	-2033.7603	0.1250	-254.1455
Total			-445.6696 (269)
Total CO2, kg/year			-99.7069 (272)
CO2 emissions per m2			-0.8200 (273)
EI value			100.8007
EI rating			101 (274)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 305.7222 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	0.9500 (17)	
Infiltration rate	0.0475 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0404 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.6000	6.2000	6.0000	5.5000	5.5000	4.8000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000 (22)
Wind factor	1.6500	1.5500	1.5000	1.3750	1.3750	1.2000	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250 (22a)
Adj infilt rate	0.0666	0.0626	0.0606	0.0555	0.0555	0.0485	0.0464	0.0454	0.0505	0.0585	0.0606	0.0656 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)

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Effective ac 0.1616 0.1576 0.1556 0.1505 0.1505 0.1434 0.1414 0.1404 0.1455 0.1535 0.1556 0.1606 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)
Door			2.1000	1.0000	2.1000		(26a)
5			1.1100	1.0536	1.1695		(27a)
10			1.1100	1.0536	1.1695		(27a)
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)
Total net area of external elements Aum(A, m2)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.2825		(33)
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)
Internal Floor 1			28.7700			18.0000	517.8600 (32d)
Internal Ceiling 1			28.7700			9.0000	258.9300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	16323.1100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.9387 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	16.6100	0.0300	0.4983
E5 Ground floor (normal)	41.0000	0.0210	0.8610
E11 Eaves (insulation at rafter level)	46.8100	0.0390	1.8256
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0150	-0.0398
R4 Ridge (vaulted ceiling)	6.5000	0.1200	0.7800
R7 Flat ceiling (inverted)	5.2200	0.1200	0.6264
E2 Other lintels (including other steel lintels)	13.7000	0.0840	1.1508
E3 Sill	12.7000	0.0430	0.5461
E4 Jamb	33.0000	0.0340	1.1220
R1 Head of roof window	1.8800	0.2400	0.4512
R2 Sill of roof window	1.8800	0.2400	0.4512
R3 Jamb of roof window	4.7200	0.2400	1.1328

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

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	85.6882 (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	16.3054	15.8981	15.6944	15.1853	15.1853	14.4724	14.2688	14.1669	14.6761	15.4908	15.6944	16.2036 (38)
Average = Sum(39)m / 12 =	101.9936	101.5863	101.3826	100.8734	100.8734	100.1606	99.9569	99.8551	100.3643	101.1789	101.3826	101.8918 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8369	0.8336	0.8319	0.8277	0.8277	0.8219	0.8202	0.8194	0.8235	0.8302	0.8319	0.8361 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8703 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	83.4510	82.2116	80.4663	77.2483	74.8387	72.1669	70.7237	72.4568	74.3438	77.2027	80.4870	83.1689	83.1689 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243	44.0243 (42c)
Average daily hot water use (litres/day)													117.3943 (43)
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932	127.1932 (44)
Energy conte	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538	199.1538 (45)
Energy content (annual)													Total = Sum(45)m = 1949.5019
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731	29.8731 (46)
Water storage loss:													200.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.8640 (55)
Enter (49) or (54) in (55)													
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002	249.2002 (62)
WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002	249.2002 (64)
Total per year (kWh/year) = Sum(64)m =													2538.7579 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	107.1654	95.1742	102.0206	91.7599	90.3750	82.9775	82.9619	85.3565	85.3081	93.2901	96.9692	106.2557	106.2557 (65)

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

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Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.9816	29.2940	23.8235	18.0359	13.4821	11.3821	12.2988	15.9864	21.4569	27.2445	31.7984	33.8983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.2956	433.7503	422.5245	398.6261	368.4586	340.1054	321.1638	316.7090	327.9349	351.8333	382.0008	410.3539	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	(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)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	(71)
Water heating gains (Table 5)	144.0396	141.6283	137.1245	127.4444	121.4718	115.2465	111.5079	114.7265	118.4834	125.3899	134.6794	142.8169	(72)
Total internal gains	718.8138	717.1696	695.9695	656.6033	615.9094	579.2311	557.4675	559.9190	580.3722	616.9647	660.9755	699.5661	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
North	2.0700	14.5262	0.7600	0.7600	0.7000	0.7700	11.0858	(74)					
East	4.4400	27.2276	0.7600	0.7600	0.7000	0.7700	44.5694	(76)					
South	4.5500	60.1191	0.7600	0.7600	0.7000	0.7700	100.8483	(78)					
West	7.5600	27.2276	0.7600	0.7600	0.7000	0.7700	75.8885	(80)					
East	1.1100	37.0000	0.6800	0.6800	0.7000	1.0000	17.5944	(82)					
West	1.1100	37.0000	0.6800	0.6800	0.7000	1.0000	17.5944	(82)					
Solar gains	267.5808	419.0710	640.9325	903.3519	1024.6841	1144.6104	993.9499	932.8344	765.9108	506.6930	314.3779	217.2681	(83)
Total gains	986.3946	1136.2406	1336.9019	1559.9553	1640.5935	1723.8415	1551.4174	1492.7534	1346.2831	1123.6577	975.3535	916.8342	(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)	44.4557	44.6340	44.7236	44.9494	44.9494	45.2693	45.3615	45.4078	45.1774	44.8136	44.7236	44.5001	21.0000	(85)
tau	3.9637	3.9756	3.9816	3.9966	3.9966	4.0180	4.0241	4.0272	4.0118	3.9876	3.9816	3.9667		
util living area	0.9198	0.8797	0.8027	0.6803	0.5439	0.3893	0.3261	0.3253	0.4705	0.7029	0.8664	0.9290	(86)	
Living	20.2908	20.4260	20.6066	20.7744	20.8701	20.9117	20.9188	20.9191	20.9013	20.7956	20.5427	20.2753		
Non living	19.4094	19.5747	19.7884	19.9808	20.0826	20.1272	20.1347	20.1357	20.1179	20.0094	19.7217	19.3925		
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0		
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0		
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10		
MIT	20.6372	20.4260	20.6066	20.7744	20.8701	20.9117	20.9188	20.9191	20.9013	20.7956	20.5427	20.3767	(87)	
Th 2	20.2215	20.2243	20.2258	20.2294	20.2294	20.2344	20.2359	20.2366	20.2330	20.2272	20.2258	20.2222	(88)	
util rest of house	0.9069	0.8623	0.7782	0.6482	0.5047	0.3472	0.2782	0.2756	0.4192	0.6602	0.8435	0.9169	(89)	
MIT 2	19.8977	19.5747	19.7884	19.9808	20.0826	20.1272	20.1347	20.1357	20.1179	20.0094	19.7217	19.5420	(90)	
Living area fraction	20.1315	19.8438	20.0470	20.2317	20.3315	20.3751	20.3825	20.3833	20.3655	20.2579	19.9812	19.8058	(92)	
Temperature adjustment	20.1315	19.8438	20.0470	20.2317	20.3315	20.3751	20.3825	20.3833	20.3655	20.2579	19.9812	19.8058	(93)	
adjusted MIT	20.1315	19.8438	20.0470	20.2317	20.3315	20.3751	20.3825	20.3833	20.3655	20.2579	19.9812	19.8058	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	892.9798	968.9705	1032.2862	1011.3423	836.7765	612.0149	445.9023	425.7178	576.5045	743.8642	814.8041	833.7978	(94)
Ext temp.	6.7000	6.9000	7.7000	9.2000	11.7000	14.2000	15.9000	16.1000	14.5000	12.1000	9.4000	7.1000	(95)
Heat loss rate W	1369.9225	1314.9124	1251.7753	1112.8005	870.6926	618.5054	448.0581	427.7095	588.6908	825.4058	1072.7477	1294.6214	(97)
Space heating kWh	354.8454	232.4730	163.2999	73.0499	25.2335	0.0000	0.0000	0.0000	0.0000	60.6670	185.7194	342.8528	(98a)
Space heating requirement - total per year (kWh/year)												1438.1408	
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	354.8454	232.4730	163.2999	73.0499	25.2335	0.0000	0.0000	0.0000	0.0000	60.6670	185.7194	342.8528	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1438.1408	
Space heating per m ²										(98c) / (4) =		11.8006	(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 %)													374.1134	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(207)
													0.0000	(208)
Space heating requirement	354.8454	232.4730	163.2999	73.0499	25.2335	0.0000	0.0000	0.0000	0.0000	60.6670	185.7194	342.8528	(98)	
Space heating efficiency (main heating system 1)	374.1134	374.1134	374.1134	374.1134	374.1134	0.0000	0.0000	0.0000	0.0000	374.1134	374.1134	374.1134	(210)	
Space heating fuel (main heating system)	94.8497	62.1397	43.6498	19.5261	6.7449	0.0000	0.0000	0.0000	0.0000	16.2162	49.6425	91.6441	(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)														

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating														
Water heating requirement	251.9361	222.6818	236.4629	207.8736	201.4385	181.4603	179.1435	186.3454	188.4695	210.2056	223.5404	249.2002	249.2002	(64)
Efficiency of water heater	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	(216)
(217)m	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	(217)
Fuel for water heating, kWh/month	125.7218	111.1232	118.0003	103.7336	100.5223	90.5527	89.3966	92.9905	94.0505	104.8973	111.5517	124.3565	124.3565	(219)
Space cooling fuel requirement														
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	26.4827	23.9198	26.4827	25.6284	26.4827	25.6284	26.4827	26.4827	25.6284	26.4827	25.6284	26.4827	26.4827	(231)
Lighting	28.8686	23.1595	20.8526	15.2775	11.8008	9.6413	10.7651	13.9928	18.1753	23.8470	26.9351	29.6710	29.6710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-84.2546	-104.0542	-147.3787	-163.2926	-169.1132	-162.2102	-154.5305	-151.5346	-137.5043	-119.0009	-88.0888	-71.2663	-71.2663	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-51.1580	-87.8447	-177.7353	-279.2731	-348.1808	-396.1578	-346.8336	-320.1779	-238.2787	-138.0066	-65.9714	-38.6070	-38.6070	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													384.4131	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													200.3918	(216)
Water heating fuel used													1266.8972	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)														
mechanical ventilation fans (SFP = 0.8360)													311.8122	(230a)
Total electricity for the above, kWh/year													311.8122	(231)
Electricity for lighting (calculated in Appendix L)													232.9865	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-4040.4539	(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													-1844.3449	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	384.4131	21.5100	82.6873	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1266.8972	21.5100	272.5096	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	311.8122	21.5100	67.0708	(249)
Energy for lighting	232.9865	21.5100	50.1154	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1552.2290	21.5100	-333.8845	
PV Unit electricity exported	-2488.2248	5.5900	-139.0918	
Total			-472.9762	(252)
Total energy cost			-0.5932	(255)

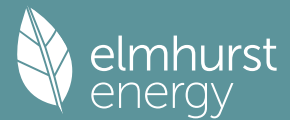
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	384.4131	0.1571	60.4033	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1266.8972	0.1409	178.4882	(264)
Space and water heating			238.8914	(265)
Pumps, fans and electric keep-hot	311.8122	0.1387	43.2522	(267)
Energy for lighting	232.9865	0.1443	33.6272	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1552.2290	0.1353	-210.0724	
PV Unit electricity exported	-2488.2248	0.1259	-313.1535	
Total			-523.2259	(269)
Total CO2, kg/year			-207.4551	(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	384.4131	1.5817	608.0147	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1266.8972	1.5209	1926.8807	(278)
Space and water heating			2534.8954	(279)
Pumps, fans and electric keep-hot	311.8122	1.5128	471.7095	(281)
Energy for lighting	232.9865	1.5338	357.3625	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1552.2290	1.5002	-2328.6591	
PV Unit electricity exported	-2488.2248	0.4620	-1149.4838	

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Total
Total Primary energy kWh/year

-3478.1429 (283)
-114.1756 (286)

SAP 10 EPC IMPROVEMENTS

SEC1 - ASHP ROI TF 0.15 improv

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 60	-41 kg (20.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£60	0.34 kg/m ²	A 100
Total Savings	£60	0.34 kg/m²	A 101

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

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£472	£401	£72
Space heating	£150	£167	-£17
Water heating	£273	£183	£89
Lighting	£50	£50	£0
Generated (PV)	-£473	-£461	-£12
Total cost of fuels	-£1	-£60	£60
Total cost of uses	£0	-£61	£60
Delivered energy	-15 kWh/m ²	-18 kWh/m ²	3 kWh/m ²
Carbon dioxide emissions	-0.2 tonnes	-0.2 tonnes	0.0 tonnes
CO2 emissions per m ²	-2 kg/m ²	-2 kg/m ²	0 kg/m ²
Primary energy	-1 kWh/m ²	-4 kWh/m ²	3 kWh/m ²

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 ²)	Storey height (m)	Volume (m ³)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 305.7222 (5)

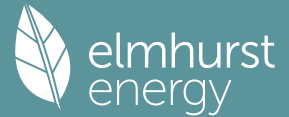
2. Ventilation rate

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure Test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			0.9500 (17)
Infiltration rate			0.0475 (18)
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.0404 (21)

	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												

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Balanced mechanical ventilation with heat recovery	0.0515	0.0505	0.0495	0.0444	0.0434	0.0384	0.0384	0.0373	0.0404	0.0434	0.0454	0.0474 (22b)
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1465	0.1455	0.1445	0.1394	0.1384	0.1334	0.1334	0.1323	0.1354	0.1384	0.1404	0.1424 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)
Door			2.1000	1.0000	2.1000		(26a)
5			1.1100	1.0536	1.1695		(27a)
10			1.1100	1.0536	1.1695		(27a)
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)
Total net area of external elements Aum(A, m2)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)					76.2825		(33)
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)
Internal Floor 1			28.7700			18.0000	517.8600 (32d)
Internal Ceiling 1			28.7700			9.0000	258.9300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16323.1100 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 133.9387 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	16.6100	0.0300	0.4983
E5 Ground floor (normal)	41.0000	0.0210	0.8610
E11 Eaves (insulation at rafter level)	46.8100	0.0390	1.8256
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0150	-0.0398
R4 Ridge (vaulted ceiling)	6.5000	0.1200	0.7800
R7 Flat ceiling (inverted)	5.2200	0.1200	0.6264
E2 Other lintels (including other steel lintels)	13.7000	0.0840	1.1508
E3 Sill	12.7000	0.0430	0.5461
E4 Jamb	33.0000	0.0340	1.1220
R1 Head of roof window	1.8800	0.2400	0.4512
R2 Sill of roof window	1.8800	0.2400	0.4512
R3 Jamb of roof window	4.7200	0.2400	1.1328

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4056 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 85.6882 (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	14.7779	14.6761	14.5743	14.0651	13.9633	13.4541	13.4541	13.3523	13.6578	13.9633	14.1669	14.3706 (38)
Average = Sum(39)m / 12 =	100.4661	100.3643	100.2624	99.7533	99.6514	99.1423	99.1423	99.0404	99.3459	99.6514	99.8551	100.0588 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8244	0.8235	0.8227	0.8185	0.8177	0.8135	0.8135	0.8127	0.8152	0.8177	0.8194	0.8210 (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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	83.4510	82.2116	80.4663	77.2483	74.8387	72.1669	70.7237	72.4568	74.3438	77.2027	80.4870	83.1689 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243 (42c)
Average daily hot water use (litres/day)												117.3943 (43)
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932 (44)
Energy conte	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538 (45)
Energy content (annual)												Total = Sum(45)m = 1949.5019
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731 (46)
Water storage loss:												200.0000 (47)
Store volume												1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8640 (55)
Enter (49) or (54) in (55)												
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	251.9361	222.6818	235.0671	201.1200	188.6442	168.8536	166.1166	174.2489	183.0666	208.8099	223.5404	249.2002 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)

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Effective solar volume													75.0000 (H14)
Reference volume													225.0000 (H15)
Storage tank correction coefficient													1.3161 (H16)
Heat delivered to hot water													611.2380 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													611.2380
Solar input	-0.0000	-16.2263	-57.8021	-78.9837	-102.4331	-94.2945	-93.5757	-82.1995	-57.1219	-28.6011	-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	251.9361	206.4555	177.2650	122.1363	86.2112	74.5590	72.5408	92.0494	125.9447	180.2088	223.5404		249.2002 (64)
	Total per year (kWh/year) = Sum(64)m =											1862.0475 (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	107.1654	95.1742	100.9040	86.3571	80.1395	72.8921	72.5404	75.6794	80.9858	92.1735	96.9692		106.2557 (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	
	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	32.9816	29.2940	23.8235	18.0359	13.4821	11.3821	12.2988	15.9864	21.4569	27.2445	31.7984	33.8983	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.2956	433.7503	422.5245	398.6261	368.4586	340.1054	321.1638	316.7090	327.9349	351.8333	382.0008	410.3539	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	(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)													
	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	(71)
Water heating gains (Table 5)													
	144.0396	141.6283	135.6237	119.9404	107.7144	101.2391	97.5005	101.7196	112.4802	123.8891	134.6794	142.8169	(72)
Total internal gains													
	718.8138	717.1696	694.4687	649.0993	602.1521	565.2236	543.4600	546.9120	574.3690	615.4639	660.9755	699.5661	(73)

6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains						
		m ²	Table 6a	Specific data	Specific data	Factor	W						
			W/m ²	or Table 6b	or Table 6c	Table 6d							
North		2.0700	10.6334	0.7600	0.7000	0.7700	8.1150 (74)						
East		4.4400	19.6403	0.7600	0.7000	0.7700	32.1496 (76)						
South		4.5500	46.7521	0.7600	0.7000	0.7700	78.4255 (78)						
West		7.5600	19.6403	0.7600	0.7000	0.7700	54.7412 (80)						
East		1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)						
West		1.1100	26.0000	0.6800	0.7000	1.0000	12.3636 (82)						
Solar gains	198.1584	365.2821	561.1908	778.1584	932.6495	948.8741	905.5434	789.3435	637.5321	421.4566	242.6989	165.9586	(83)
Total gains	916.9722	1082.4517	1255.6594	1427.2578	1534.8016	1514.0978	1449.0035	1336.2556	1211.9011	1036.9204	903.6744	865.5247	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.1316	45.1774	45.2233	45.4541	45.5006	45.7343	45.7343	45.7813	45.6405	45.5006	45.4078	45.3153	21.0000 (85)
alpha	4.0088	4.0118	4.0149	4.0303	4.0334	4.0490	4.0490	4.0521	4.0427	4.0334	4.0272	4.0210	
util living area	0.9577	0.9236	0.8546	0.7291	0.5699	0.4118	0.2994	0.3381	0.5396	0.8011	0.9299	0.9651	(86)
Living	20.0035	20.2143	20.4850	20.7317	20.8634	20.9110	20.9210	20.9193	20.8873	20.6864	20.2926	19.9497	
Non living	19.0586	19.3211	19.6513	19.9420	20.0851	20.1345	20.1423	20.1421	20.1133	19.8995	19.4256	18.9936	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.4902	20.2143	20.4850	20.7317	20.8634	20.9110	20.9210	20.9193	20.8873	20.6864	20.2926	20.0967	(87)
Th 2	20.2323	20.2330	20.2337	20.2373	20.2380	20.2416	20.2416	20.2424	20.2402	20.2380	20.2366	20.2351	(88)
util rest of house	0.9512	0.9127	0.8357	0.6990	0.5302	0.3653	0.2485	0.2835	0.4873	0.7695	0.9180	0.9597	(89)
MIT 2	19.7644	19.3211	19.6513	19.9420	20.0851	20.1345	20.1423	20.1421	20.1133	19.8995	19.4256	19.2173	(90)
Living area fraction													FLA = Living area / (4) =
MIT	19.9938	19.6034	19.9148	20.1916	20.3311	20.3799	20.3884	20.3878	20.3579	20.1482	19.6997	19.4952	(92)
Temperature adjustment													0.0000
adjusted MIT	19.9938	19.6034	19.9148	20.1916	20.3311	20.3799	20.3884	20.3878	20.3579	20.1482	19.6997	19.4952	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	870.1886	976.9241	1038.5784	994.9913	821.4262	566.0126	374.4182	392.9522	600.5932	793.7334	820.8218	825.2106	(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	1576.6942	1475.6998	1345.0052	1126.3750	860.0990	573.0323	375.5952	394.9491	621.7016	951.4915	1258.1396	1530.4222	(97)
Space heating kWh	525.6402	335.1772	227.9815	94.5963	28.7726	0.0000	0.0000	0.0000	0.0000	117.3721	314.8688	524.6775	(98a)
Space heating requirement - total per year (kWh/year)													
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)													
Space heating kWh	525.6402	335.1772	227.9815	94.5963	28.7726	0.0000	0.0000	0.0000	0.0000	117.3721	314.8688	524.6775	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													
Space heating per m ²												(98c) / (4) =	
												17.7984 (99)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													374.9485 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	525.6402	335.1772	227.9815	94.5963	28.7726	0.0000	0.0000	0.0000	0.0000	117.3721	314.8688	524.6775	(98)
Space heating efficiency (main heating system 1)	374.9485	374.9485	374.9485	374.9485	374.9485	0.0000	0.0000	0.0000	0.0000	374.9485	374.9485	374.9485	(210)
Space heating fuel (main heating system)	140.1900	89.3929	60.8034	25.2292	7.6737	0.0000	0.0000	0.0000	0.0000	31.3035	83.9766	139.9332	(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	251.9361	206.4555	177.2650	122.1363	86.2112	74.5590	72.5408	92.0494	125.9447	180.2088	223.5404	249.2002	(64)
Efficiency of water heater (217)m	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	200.5349	(216)
Fuel for water heating, kWh/month	125.6320	102.9524	88.3961	60.9053	42.9906	37.1801	36.1737	45.9019	62.8044	89.8640	111.4721	124.2677	(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	33.2772	30.0568	33.2772	32.2037	33.2772	32.2037	33.2772	33.2772	32.2037	33.2772	32.2037	33.2772	(231)
Lighting	28.8686	23.1595	20.8526	15.2775	11.8008	9.6413	10.7651	13.9928	18.1753	23.8470	26.9351	29.6710	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-67.8105	-95.7747	-135.3901	-146.5870	-151.6640	-139.5838	-137.8334	-132.5515	-121.4440	-106.6154	-74.2245	-58.4624	(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	-32.3625	-71.3853	-149.3024	-234.9571	-319.7016	-323.8436	-319.4697	-266.9965	-191.4822	-107.0763	-44.5951	-25.3653	(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													578.5025 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													200.5349
Water heating fuel used													928.5404 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360) mechanical ventilation fans (SFP = 0.8360) pump for solar water heating													311.8122 (230a) 80.0000 (230g) 391.8122 (231) 232.9865 (232)
Total electricity for the above, kWh/year													
Electricity for lighting (calculated in Appendix L)													
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-3454.4788 (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													-1322.6372 (238)

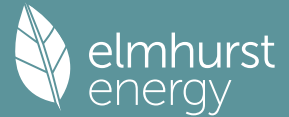
10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	578.5025	16.4900	95.3951 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	928.5404	16.4900	153.1163 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	311.8122	16.4900	51.4178 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	232.9865	16.4900	38.4195 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1367.9412	16.4900	-225.5735
PV Unit electricity exported	-2086.5375	5.5900	-116.6374
Total			-342.2110 (252)
Total energy cost			9.3297 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.0201 (257)
SAP value		99.6737
SAP rating (Section 12)		100 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	578.5025	0.1570	90.8243 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	928.5404	0.1459	135.4487 (264)
Space and water heating			226.2730 (265)
Pumps, fans and electric keep-hot	391.8122	0.1387	54.3492 (267)
Energy for lighting	232.9865	0.1443	33.6272 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1367.9412	0.1353	-185.0218
PV Unit electricity exported	-2086.5375	0.1247	-260.1465
Total			-445.1683 (269)
Total CO2, kg/year			-130.9190 (272)
CO2 emissions per m2			-1.0700 (273)
EI value			101.0513
EI rating			101 (274)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	93.1000 (1b)	x 2.4000 (2b)	= 223.4400 (1b) - (3b)
First floor	28.7700 (1c)	x 2.8600 (2c)	= 82.2822 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 305.7222 (5)

2. Ventilation rate

			m3 per hour
Number of open chimneys	0 * 80 =		0.0000 (6a)
Number of open flues	0 * 20 =		0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =		0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =		0.0000 (6d)
Number of flues attached to other heater	0 * 35 =		0.0000 (6e)
Number of blocked chimneys	0 * 20 =		0.0000 (6f)
Number of intermittent extract fans	0 * 10 =		0.0000 (7a)
Number of passive vents	0 * 10 =		0.0000 (7b)
Number of flueless gas fires	0 * 40 =		0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =			0.0000 / (5) = 0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			0.9500 (17)
Infiltration rate			0.0475 (18)
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.0404 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.6000	6.2000	6.0000	5.5000	5.5000	4.8000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000 (22)
Wind factor	1.6500	1.5500	1.5000	1.3750	1.3750	1.2000	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250 (22a)
Adj infilt rate	0.0666	0.0626	0.0606	0.0555	0.0555	0.0485	0.0464	0.0454	0.0505	0.0585	0.0606	0.0656 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1616	0.1576	0.1556	0.1505	0.1505	0.1434	0.1414	0.1404	0.1455	0.1535	0.1556	0.1606 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.00)			18.6200	0.9615	17.9038		(27)
Door			2.1000	1.0000	2.1000		(26a)
5			1.1100	1.0536	1.1695		(27a)
10			1.1100	1.0536	1.1695		(27a)
Floor 1 P/a 0.44			93.1000	0.1200	11.1720	110.0000	10241.0000 (28a)
External Wall 1 Render	191.5000	18.5600	172.9400	0.1600	27.6704	9.0000	1556.4600 (29a)
External Wall 2 Dormer	6.3900	2.1600	4.2300	0.1600	0.6768	9.0000	38.0700 (29a)
External Wall 3 Attic	44.8500		44.8500	0.0900	4.0365	18.0000	807.3000 (29a)
External Roof 1 Sloping	37.5600	2.2200	35.3400	0.1300	4.5942	9.0000	318.0600 (30)
External Roof 2 "ATTIC"	64.3300		64.3300	0.0900	5.7897	9.0000	578.9700 (30)
Total net area of external elements Aum(A, m2)			437.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.2825		(33)
Internal Wall 1 GF			160.5600			9.0000	1445.0400 (32c)
Internal Wall 2 FF			62.3800			9.0000	561.4200 (32c)
Internal Floor 1			28.7700			18.0000	517.8600 (32d)
Internal Ceiling 1			28.7700			9.0000	258.9300 (32e)

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Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16323.1100 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 133.9387 (35)

List of Thermal Bridges

Element	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	16.6100	0.0300	0.4983
E5 Ground floor (normal)	41.0000	0.0210	0.8610
E11 Eaves (insulation at rafter level)	46.8100	0.0390	1.8256
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0150	-0.0398
R4 Ridge (vaulted ceiling)	6.5000	0.1200	0.7800
R7 Flat ceiling (inverted)	5.2200	0.1200	0.6264
E2 Other lintels (including other steel lintels)	13.7000	0.0840	1.1508
E3 Sill	12.7000	0.0430	0.5461
E4 Jamb	33.0000	0.0340	1.1220
R1 Head of roof window	1.8800	0.2400	0.4512
R2 Sill of roof window	1.8800	0.2400	0.4512
R3 Jamb of roof window	4.7200	0.2400	1.1328

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4056 (36)
 Point Thermal bridges 0.0000 (36a) =
 Total fabric heat loss (33) + (36) + (36a) = 85.6882 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	16.3054	15.8981	15.6944	15.1853	15.1853	14.4724	14.2688	14.1669	14.6761	15.4908	15.6944	16.2036 (38)
Heat transfer coeff	101.9936	101.5863	101.3826	100.8734	100.8734	100.1606	99.9569	99.8551	100.3643	101.1789	101.3826	101.8918 (39)
Average = Sum(39)m / 12 =												100.9583

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.8369	0.8336	0.8319	0.8277	0.8277	0.8219	0.8202	0.8194	0.8235	0.8302	0.8319	0.8361 (40)
HLP (average)												0.8284
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8703 (42)

Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	83.4510	82.2116	80.4663	77.2483	74.8387	72.1669	70.7237	72.4568	74.3438	77.2027	80.4870	83.1689 (42b)
Hot water usage for other uses	44.0243	42.4234	40.8226	39.2217	37.6208	36.0199	36.0199	37.6208	39.2217	40.8226	42.4234	44.0243 (42c)
Average daily hot water use (litres/day)												117.3943 (43)

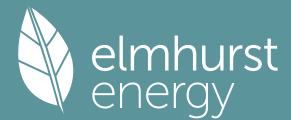
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	127.4753	124.6350	121.2889	116.4700	112.4595	108.1868	106.7436	110.0775	113.5654	118.0253	122.9104	127.1932 (44)
Energy conte	201.8897	177.4786	186.4165	159.4416	151.3921	133.0283	129.0971	136.2990	140.0375	160.1592	175.1084	199.1538 (45)
Energy content (annual)												Total = Sum(45)m = 1949.5019
Distribution loss (46)m = 0.15 x (45)m	30.2835	26.6218	27.9625	23.9162	22.7088	19.9542	19.3646	20.4448	21.0056	24.0239	26.2663	29.8731 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	251.9361	222.6818	235.0671	201.1200	188.6442	168.8536	166.1166	174.2489	183.0666	208.8099	223.5404	249.2002 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												764.2010 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												764.2010
Solar input	-9.1005	-26.5923	-72.1996	-95.4619	-113.2216	-113.8678	-102.5059	-99.3152	-74.8077	-44.6965	-12.4321	-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	242.8356	196.0895	162.8675	105.6582	75.4226	54.9858	63.6107	74.9338	108.2589	164.1133	211.1084	249.2002 (64)
												Total per year (kWh/year) = Sum(64)m = 1709.0845 (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	107.1654	95.1742	100.9040	86.3571	80.1395	72.8921	72.5404	75.6794	80.9858	92.1735	96.9692	106.2557 (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	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155	172.2155 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.9816	29.2940	23.8235	18.0359	13.4821	11.3821	12.2988	15.9864	21.4569	27.2445	31.7984	33.8983 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.2956	433.7503	422.5245	398.6261	368.4586	340.1054	321.1638	316.7090	327.9349	351.8333	382.0008	410.3539 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918	55.0918 (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)

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Losses e.g. evaporation (negative values) (Table 5)	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	-114.8104	(71)
Water heating gains (Table 5)	144.0396	141.6283	135.6237	119.9404	107.7144	101.2391	97.5005	101.7196	112.4802	123.8891	134.6794	142.8169	(72)
Total internal gains	718.8138	717.1696	694.4687	649.0993	602.1521	565.2236	543.4600	546.9120	574.3690	615.4639	660.9755	699.5661	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
North	2.0700	14.5262	0.7600	0.7000	0.7700	11.0858 (74)							
East	4.4400	27.2276	0.7600	0.7000	0.7700	44.5694 (76)							
South	4.5500	60.1191	0.7600	0.7000	0.7700	100.8483 (78)							
West	7.5600	27.2276	0.7600	0.7000	0.7700	75.8885 (80)							
East	1.1100	37.0000	0.6800	0.7000	1.0000	17.5944 (82)							
West	1.1100	37.0000	0.6800	0.7000	1.0000	17.5944 (82)							
Solar gains	267.5808	419.0710	640.9325	903.3519	1024.6841	1144.6104	993.9499	932.8344	765.9108	506.6930	314.3779	217.2681	(83)
Total gains	986.3946	1136.2406	1335.4011	1552.4513	1626.8362	1709.8340	1537.4099	1479.7465	1340.2799	1122.1569	975.3535	916.8342	(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	44.4557	44.6340	44.7236	44.9494	44.9494	45.2693	45.3615	45.4078	45.1774	44.8136	44.7236	44.5001	
alpha	3.9637	3.9756	3.9816	3.9966	3.9966	4.0180	4.0241	4.0272	4.0118	3.9876	3.9816	3.9667	
util living area	0.9198	0.8797	0.8031	0.6825	0.5478	0.3923	0.3290	0.3281	0.4724	0.7035	0.8664	0.9290	(86)
Living	20.2908	20.4260	20.6059	20.7726	20.8688	20.9114	20.9186	20.9189	20.9010	20.7952	20.5427	20.2753	
Non living	19.4094	19.5747	19.7876	19.9789	20.0814	20.1269	20.1346	20.1356	20.1177	20.0090	19.7217	19.3925	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6372	20.4260	20.6059	20.7726	20.8688	20.9114	20.9186	20.9189	20.9010	20.7952	20.5427	20.3767	(87)
Th 2	20.2215	20.2243	20.2258	20.2294	20.2294	20.2344	20.2359	20.2366	20.2330	20.2272	20.2258	20.2222	(88)
util rest of house	0.9069	0.8623	0.7787	0.6505	0.5085	0.3500	0.2807	0.2780	0.4209	0.6608	0.8435	0.9169	(89)
MIT 2	19.8977	19.5747	19.7876	19.9789	20.0814	20.1269	20.1346	20.1356	20.1177	20.0090	19.7217	19.5420	(90)
Living area fraction													fLA = Living area / (4) = 0.3161 (91)
MIT	20.1315	19.8438	20.0463	20.2298	20.3303	20.3749	20.3824	20.3832	20.3653	20.2575	19.9812	19.8058	(92)
Temperature adjustment													0.0000
adjusted MIT	20.1315	19.8438	20.0463	20.2298	20.3303	20.3749	20.3824	20.3832	20.3653	20.2575	19.9812	19.8058	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9053	0.8528	0.7726	0.6505	0.5137	0.3578	0.2900	0.2876	0.4300	0.6626	0.8354	0.9094	(94)
Useful gains	892.9798	968.9705	1031.7279	1009.9176	835.7769	611.8017	445.8196	425.6439	576.2984	743.5554	814.8041	833.7978	(95)
Ext temp.	6.7000	6.9000	7.7000	9.2000	11.7000	14.2000	15.9000	16.1000	14.5000	12.1000	9.4000	7.1000	(96)
Heat loss rate W	1369.9225	1314.9124	1251.6977	1112.6107	870.5631	618.4780	448.0472	427.6997	588.6640	825.3642	1072.7477	1294.6214	(97)
Space heating kWh	354.8454	232.4730	163.6576	73.9390	25.8810	0.0000	0.0000	0.0000	0.0000	60.8657	185.7194	342.8528	(98a)
Space heating requirement - total per year (kWh/year)													1440.2339
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	354.8454	232.4730	163.6576	73.9390	25.8810	0.0000	0.0000	0.0000	0.0000	60.8657	185.7194	342.8528	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													1440.2339
Space heating per m2													(98c) / (4) = 11.8178 (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 %)													374.1134 (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	354.8454	232.4730	163.6576	73.9390	25.8810	0.0000	0.0000	0.0000	0.0000	60.8657	185.7194	342.8528	(98)
Space heating efficiency (main heating system 1)	374.1134	374.1134	374.1134	374.1134	374.1134	0.0000	0.0000	0.0000	0.0000	374.1134	374.1134	374.1134	(210)
Space heating fuel (main heating system)	94.8497	62.1397	43.7454	19.7638	6.9180	0.0000	0.0000	0.0000	0.0000	16.2693	49.6425	91.6441	(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	242.8356	196.0895	162.8675	105.6582	75.4226	54.9858	63.6107	74.9338	108.2589	164.1133	211.1084	249.2002	(64)
Efficiency of water heater (217)m	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	200.3918	(216)
Fuel for water heating, kWh/month	121.1804	97.8531	81.2745	52.7258	37.6376	27.4391	31.7432	37.3936	54.0236	81.8962	105.3478	124.3565	(219)
Space cooling fuel requirement													

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(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	33.2772	30.0568	33.2772	32.2037	33.2772	32.2037	33.2772	33.2772	32.2037	33.2772	32.2037	33.2772	33.2772	(231)
Lighting	28.8686	23.1595	20.8526	15.2775	11.8008	9.6413	10.7651	13.9928	18.1753	23.8470	26.9351	29.6710	29.6710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-84.3294	-103.6115	-143.9945	-155.0637	-155.9907	-146.2756	-141.4295	-139.7688	-131.2048	-117.2925	-88.1072	-71.4447	-71.4447	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-51.0832	-88.2874	-181.1195	-287.5019	-361.3033	-412.0924	-359.9346	-331.9437	-244.5782	-139.7150	-65.9530	-38.4286	-38.4286	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													384.9726	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													200.3918	
Water heating fuel used													852.8715	(219)
Space cooling fuel													0.0000	(221)

Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8360)														
mechanical ventilation fans (SFP = 0.8360)													311.8122	(230a)
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													391.8122	(231)
Electricity for lighting (calculated in Appendix L)													232.9865	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-4040.4539	(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													-2177.8111	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	384.9726	21.5100	82.8076	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	852.8715	21.5100	183.4527	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	311.8122	21.5100	67.0708	(249)
Pump for solar water heating	80.0000	21.5100	17.2080	(249)
Energy for lighting	232.9865	21.5100	50.1154	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1478.5129	21.5100	-318.0281	
PV Unit electricity exported	-2561.9410	5.5900	-143.2125	
Total			-461.2406	(252)
Total energy cost			-60.5862	(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	384.9726	0.1571	60.4819	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	852.8715	0.1469	125.2625	(264)
Space and water heating			185.7445	(265)
Pumps, fans and electric keep-hot	391.8122	0.1387	54.3492	(267)
Energy for lighting	232.9865	0.1443	33.6272	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1478.5129	0.1359	-200.9339	
PV Unit electricity exported	-2561.9410	0.1255	-321.6461	
Total			-522.5799	(269)
Total CO2, kg/year			-248.8591	(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	384.9726	1.5816	608.8655	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	852.8715	1.5433	1316.2737	(278)
Space and water heating			1925.1393	(279)
Pumps, fans and electric keep-hot	391.8122	1.5128	592.7335	(281)
Energy for lighting	232.9865	1.5338	357.3625	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1478.5129	1.5023	-2221.2219	
PV Unit electricity exported	-2561.9410	0.4608	-1180.6234	
Total			-3401.8453	(283)
Total Primary energy kWh/year			-526.6101	(286)