



# Energy Statement

## PROPOSED DWELLING HOUSE AT LAND SOUTH OF LOCHHEAD COTTAGE, RORA, PETERHEAD

for

**MR BRIAN CLUBB**

06/03/2024

At the design stage of the proposed dwelling house at Land South of Lochhead Cottage, Rora several options were considered for high efficiency systems with low carbon emissions with the most suitable systems being employed in the final proposals.

It was decided early on that the applicant wanted to create a high performing building envelope in the proposed design. The timber panel construction helps to create an airtight, efficient build. With high levels of insulation specified in the walls, floors and ceiling, and double glazed doors and windows specified throughout, the high performing building envelope minimises heat loss.

The proposed house has been designed on the principles of passive design. Openings to the north are minimised with large glazing areas elsewhere, particularly to the southern elevations, providing valuable solar gains to the internal spaces.

The applicant chose to install an air source heat pump to provide primary heating and hot water for the proposed new house. This decision was reached primarily for cost reasons having considered various alternative options such as a wood pellet boiler. The applicant will also install 4.0kW of PV panels on the garage.

The above methods combined allow the proposed dwelling to comply with on-site carbon reductions required in the Scottish Planning Policy and Aberdeenshire Council's supplementary planning guidance – Carbon Neutrality in New Development.

Copies of the SAP and U-value calculations for the proposed dwelling are enclosed with this energy statement.

Samantha Thompson  
Energy Assessor

ST.0224/06 - ES



# Full SAP Calculation Printout



Property Reference	0224/06-Clubb		Issued on Date	06/03/2024	
Assessment Reference	00001	Prop Type Ref			
Property	Land South of Lochhead Cottage, Rora, Aberdeenshire				
SAP Rating	89 B	DER	2.32	TER	4.19
Environmental	98 A	% DER < TER	N/A		
CO <sub>2</sub> Emissions (t/year)	0.41	DDER	14.84	TDER	28.07
Compliance Check	See Compliance Report	% DDER < TDER	47.13		
Assessor Details	Mr. Colin Thompson			Assessor ID	E355-0002
Client	Brian Clubb, Brian Clubb				

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	150.6500 (1b)	2.4300 (2b)	366.0795 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		366.0795 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 366.0795 (5)

### 2. Ventilation rate

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

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2500 (18)
Number of sides sheltered		0 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500 (21)

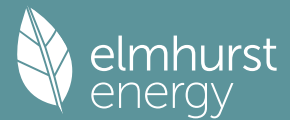
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
Effective ac	0.5687	0.5625	0.5563	0.5250	0.5188	0.5000	0.5000	0.5000	0.5000	0.5188	0.5312	0.5437 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Half Glazed Door			4.2000	1.4000	5.8800		(26a)
Fully Glazed Door (Uw = 1.40)			8.4000	1.3258	11.1364		(27)
Windows (Uw = 1.40)			26.0700	1.3258	34.5625		(27)
Ground Floor			150.6500	0.1500	22.5975	110.0000	16571.5000 (28a)
Blockwork Walls	138.0000	38.6700	99.3300	0.1700	16.8861	9.0000	893.9700 (29a)
Ceiling Tie	150.6500		150.6500	0.1200	18.0780	9.0000	1355.8500 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			439.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.1405	(33)
Internal Partitions			300.5900			9.0000	2705.3100 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21526.6300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							142.8917 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	25.7000	0.0370	0.9509
E3 Sill	20.1000	0.0330	0.6633
E4 Jamb	45.4000	0.0310	1.4074
E5 Ground floor (normal)	56.7900	0.0970	5.5086

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E10 Eaves (insulation at ceiling level)	40.5900	0.0430	1.7454	
E12 Gable (insulation at ceiling level)	16.2000	0.0510	0.8262	
E16 Corner (normal)	12.1500	0.0380	0.4617	
E17 Corner (inverted - internal area greater than external area)	2.4300	0.0290	0.0705	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				11.6340 (36)
Point Thermal bridges				0.0000
Total fabric heat loss				(33) + (36) + (36a) = 120.7744 (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
	68.7085	67.9535	67.1985	63.4233	62.6682	60.4031	60.4031	60.4031	60.4031	62.6682	64.1783	65.6884 (38)
Heat transfer coeff												
	189.4830	188.7279	187.9729	184.1977	183.4427	181.1776	181.1776	181.1776	181.1776	183.4427	184.9527	186.4628 (39)
Average = Sum(39)m / 12 =												184.4494
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1.2578	1.2528	1.2477	1.2227	1.2177	1.2026	1.2026	1.2026	1.2026	1.2177	1.2277	1.2377 (40)
HLP (average)												1.2244
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9352 (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	89.1701	87.8458	85.9809	82.5424	79.9677	77.1127	75.5706	77.4224	79.4388	82.4937	86.0030	88.8687 (42b)
Hot water usage for other uses	47.0414	45.3308	43.6202	41.9096	40.1990	38.4884	38.4884	40.1990	41.9096	43.6202	45.3308	47.0414 (42c)
Average daily hot water use (litres/day)												125.4397 (43)
Daily hot water use	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101 (44)
Energy cont	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024 (45)
Energy content (annual)												Total = Sum(45)m = 2083.1069
Distribution loss (46)m = 0.15 x (45)m	32.3589	28.4463	29.8788	25.5553	24.2651	21.3218	20.6917	21.8460	22.4452	25.6703	28.0664	31.9204 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5800 (48)
Temperature factor from Table 2b												0.7800 (49)
Enter (49) or (54) in (55)												1.2324 (55)
Total storage loss	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (56)
If cylinder contains dedicated solar storage	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (64)
Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 3054.4945 (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	115.6149	102.6949	110.1175	99.1180	97.6738	65.2728	64.4765	67.0352	67.7631	100.7886	104.6842	114.6429 (65)

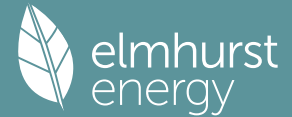
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.0230	179.3826	162.0230	167.4238	162.0230	167.4238	162.0230	162.0230	167.4238	162.0230	167.4238	162.0230 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	321.2287	324.5621	316.1622	298.2797	275.7063	254.4905	240.3170	236.9837	245.3836	263.2661	285.8395	307.0553 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760 (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)	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079 (71)
Water heating gains (Table 5)	155.3964	152.8198	148.0074	137.6638	131.2819	90.6567	86.6619	90.1011	94.1155	135.4685	145.3947	154.0899 (72)
Total internal gains	705.6761	723.7925	693.2205	670.3953	636.0392	579.5990	556.0299	556.1358	573.9508	627.7856	665.6859	690.1961 (73)

### 6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
North		8.4000	10.6334	0.7600	0.7000	0.7700	32.9303 (74)					
North		7.2600	10.6334	0.7600	0.7000	0.7700	28.4612 (74)					
South		13.4100	46.7521	0.7600	0.7000	0.7700	231.1396 (78)					
West		5.4000	19.6403	0.7600	0.7000	0.7700	39.1008 (80)					
Solar gains	331.6320	572.3590	807.5286	1048.9310	1224.4356	1238.8169	1184.5757	1049.1350	889.9166	638.7168	398.4678	283.0596 (83)
Total gains	1037.3081	1296.1516	1500.7491	1719.3263	1860.4749	1818.4159	1740.6057	1605.2708	1463.8675	1266.5024	1064.1537	973.2557 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.5576	31.6838	31.8111	32.4631	32.5967	33.0042	33.0042	33.0042	33.0042	32.5967	32.3305	32.0687
alpha	3.1038	3.1123	3.1207	3.1642	3.1731	3.2003	3.2003	3.2003	3.2003	3.1731	3.1554	3.1379
util living area	0.9787	0.9583	0.9237	0.8478	0.7265	0.5732	0.4368	0.4865	0.6987	0.8882	0.9628	0.9823 (86)
Living	19.2166	19.4914	19.8490	20.2927	20.6223	20.8106	20.8746	20.8621	20.7231	20.2828	19.6809	19.1870
Non living	17.7957	18.1449	18.5942	19.1481	19.5274	19.7295	19.7811	19.7738	19.6539	19.1528	18.4026	17.7693
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	20.0877	19.4914	19.8490	20.2927	20.6223	20.8106	20.8746	20.8621	20.7231	20.2828	19.6809	19.4406 (87)
Th 2	19.8741	19.8780	19.8820	19.9019	19.9059	19.9179	19.9179	19.9179	19.9179	19.9059	19.8979	19.8899 (88)
util rest of house	0.9744	0.9502	0.9086	0.8182	0.6747	0.4948	0.3377	0.3843	0.6259	0.8595	0.9542	0.9787 (89)
MIT 2	19.0455	18.1449	18.5942	19.1481	19.5274	19.7295	19.7811	19.7738	19.6539	19.1528	18.4026	18.1514 (90)
Living area fraction									fLA = Living area / (4) =			0.3106 (91)
MIT	19.3692	18.5631	18.9839	19.5036	19.8675	20.0653	20.1207	20.1118	19.9860	19.5037	18.7996	18.5518 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3692	18.5631	18.9839	19.5036	19.8675	20.0653	20.1207	20.1118	19.9860	19.5037	18.7996	18.5518 (93)

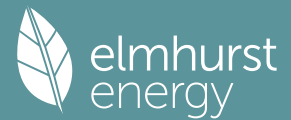
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9721	0.9379	0.8938	0.8059	0.6727	0.5061	0.3570	0.4035	0.6309	0.8468	0.9429	0.9730 (94)
Useful gains	1008.3483	1215.6056	1341.4309	1385.5805	1251.5967	920.2741	621.3623	647.7178	923.6058	1072.4792	1003.3612	946.9433 (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	2855.3557	2578.6113	2346.6324	1953.1557	1498.2611	990.1904	637.8721	672.4948	1066.4092	1633.3262	2163.8746	2676.0793 (97)
Space heating kWh	1374.1735	915.9398	747.8700	408.6542	183.5183	0.0000	0.0000	0.0000	0.0000	417.2702	835.5697	1286.4771 (98a)
Space heating requirement - total per year (kWh/year)												6169.4728
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	1374.1735	915.9398	747.8700	408.6542	183.5183	0.0000	0.0000	0.0000	0.0000	417.2702	835.5697	1286.4771 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6169.4728
Space heating per m <sup>2</sup>										(98c) / (4) =		40.9524 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												388.2524 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1374.1735	915.9398	747.8700	408.6542	183.5183	0.0000	0.0000	0.0000	0.0000	417.2702	835.5697	1286.4771 (98)
Space heating efficiency (main heating system 1)	388.2524	388.2524	388.2524	388.2524	388.2524	0.0000	0.0000	0.0000	0.0000	388.2524	388.2524	388.2524 (210)
Space heating fuel (main heating system)	353.9382	235.9135	192.6247	105.2548	47.2678	0.0000	0.0000	0.0000	0.0000	107.4740	215.2130	331.3508 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (64)
Efficiency of water heater	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054 (216)
Fuel for water heating, kWh/month	173.4710	153.7581	164.1827	146.3038	143.1583	113.2713	112.0254	116.3486	117.4789	148.4210	155.7083	171.8287 (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	6.6299	5.9883	6.6299	6.4160	6.6299	6.4160	6.6299	6.6299	6.4160	6.6299	6.4160	6.6299 (231)
Lighting	50.2032	40.2749	36.2630	26.5679	20.5218	16.7665	18.7206	24.3338	31.6072	41.4704	46.8407	51.5985 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-79.4590	-110.8988	-156.1985	-169.1531	-176.0983	-154.1298	-152.5687	-145.6164	-132.0312	-122.2161	-86.2010	-68.5990 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1589.0368 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												178.0054
Water heating fuel used												1715.9562 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 6.4670, total flow = 37.0000, SFP = 0.1748)												
mechanical ventilation fans (SFP = 0.1748)												78.0614 (230a)

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Total electricity for the above, kWh/year	78.0614 (231)
Electricity for lighting (calculated in Appendix L)	405.1684 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1553.1699 (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	2235.0527 (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	1589.0368	0.1556	247.3243 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1715.9562	0.1416	242.9115 (264)
Space and water heating			490.2358 (265)
Pumps, fans and electric keep-hot	78.0614	0.1387	10.8281 (267)
Energy for lighting	405.1684	0.1443	58.4783 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1553.1699	0.1357	-210.6948
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-210.6948 (269)
Total CO2, kg/year			348.8474 (272)
Compliance Dwelling Carbon Dioxide Emission Rate (DER)			2.3200 (273)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.3200 (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	1589.0368	1.5762	2504.6112 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1715.9562	1.5235	2614.2362 (278)
Space and water heating			5118.8473 (279)
Pumps, fans and electric keep-hot	78.0614	1.5128	118.0913 (281)
Energy for lighting	405.1684	1.5338	621.4608 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1553.1699	1.5014	-2331.9759
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-2331.9759 (283)
Total Primary energy kWh/year			3526.4235 (286)
Compliance Dwelling Delivered Energy Rate (DDER)			14.8400 (238)
EPC Dwelling Delivered Energy Rate (DDER)			14.8400 (238)

-----  
 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
 -----

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	150.6500 (1b)	x 2.4300 (2b)	= 366.0795 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 366.0795 (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		5.0000 (17)
Infiltration rate		0.2500 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)

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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 infiltr rate	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
Effective ac	0.5687	0.5625	0.5563	0.5250	0.5188	0.5000	0.5000	0.5000	0.5000	0.5188	0.5312	0.5437 (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					
Half Glazed Door			4.2000	1.2000	5.0400		(26a)					
Fully Glazed Door (Uw = 1.20)			8.1545	1.1450	9.3321		(27)					
Windows (Uw = 1.20)			25.3080	1.1450	28.9809		(27)					
Ground Floor			150.6500	0.1200	18.0780		(28a)					
Blockwork Walls	138.0000	37.6625	100.3375	0.1500	15.0506		(29a)					
Ceiling Tie	150.6500		150.6500	0.0900	13.5585		(30)					
Total net area of external elements Aum(A, m2)			439.2975				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	90.0401	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							142.8917 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							21.9649 (36)					
Point Thermal bridges							0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	112.0050 (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	68.7085	67.9535	67.1985	63.4233	62.6682	60.4031	60.4031	60.4031	60.4031	62.6682	64.1783	65.6884 (38)
Average = Sum(39)m / 12 =	180.7135	179.9585	179.2034	175.4283	174.6732	172.4081	172.4081	172.4081	172.4081	174.6732	176.1833	177.6934 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1996	1.1945	1.1895	1.1645	1.1595	1.1444	1.1444	1.1444	1.1444	1.1595	1.1695	1.1795 (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												2.9352 (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	89.1701	87.8458	85.9809	82.5424	79.9677	77.1127	75.5706	77.4224	79.4388	82.4937	86.0030	88.8687 (42b)
Hot water usage for other uses	47.0414	45.3308	43.6202	41.9096	40.1990	38.4884	38.4884	40.1990	41.9096	43.6202	45.3308	47.0414 (42c)
Average daily hot water use (litres/day)												125.4397 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy cont	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101 (44)
Energy content (annual)	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024 (45)
Distribution loss (46)m = 0.15 x (45)m	32.3589	28.4463	29.8788	25.5553	24.2651	21.3218	20.6917	21.8460	22.4452	25.6703	28.0664	31.9204 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9188 (55)
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	267.4724	236.3806	250.9387	220.4460	213.5141	192.2224	189.6911	197.3865	199.7121	222.8820	237.1865	264.5489 (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	267.4724	236.3806	250.9387	220.4460	213.5141	192.2224	189.6911	197.3865	199.7121	222.8820	237.1865	264.5489 (64)
12Total per year (kWh/year)												2692.3813 (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	113.1261	100.4470	107.6287	96.7094	95.1850	87.3251	87.2638	89.8226	89.8154	98.2998	102.2757	112.1541 (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	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599	146.7599 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.0360	179.3970	162.0360	167.4372	162.0360	167.4372	162.0360	162.0360	167.4372	162.0360	167.4372	162.0360 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	321.2287	324.5621	316.1622	298.2797	275.7063	254.4905	240.3170	236.9837	245.3836	263.2661	285.8395	307.0553 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760	37.6760 (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)	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079 (71)
Water heating gains (Table 5)	152.0512	149.4747	144.6622	134.3187	127.9368	121.2849	117.2901	120.7292	124.7436	132.1234	142.0495	150.7447 (72)
Total internal gains												

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702.3440 720.4618 689.8884 667.0636 632.7071 610.2406 586.6711 586.7769 604.5925 624.4535 662.3542 686.8640 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	FF Table 6d	Access factor Table 6d	Gains W					
North	8.1545	10.6334	0.6300	0.7000	0.7700	26.4996 (74)						
North	7.0478	10.6334	0.6300	0.7000	0.7700	22.9033 (74)						
South	13.0180	46.7521	0.6300	0.7000	0.7700	186.0024 (78)						
West	5.2422	19.6403	0.6300	0.7000	0.7700	31.4652 (80)						
Solar gains	266.8704	460.5880	649.8333	844.0943	985.3262	996.8990	953.2502	844.2585	716.1325	513.9873	320.6545	227.7833 (83)
Total gains	969.2144	1181.0498	1339.7217	1511.1579	1618.0333	1607.1396	1539.9213	1431.0354	1320.7250	1138.4408	983.0087	914.6473 (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	33.0889	33.2278	33.3678	34.0858	34.2332	34.6829	34.6829	34.6829	34.6829	34.2332	33.9398	33.6513
alpha	3.2059	3.2152	3.2245	3.2724	3.2822	3.3122	3.3122	3.3122	3.3122	3.2822	3.2627	3.2434
util living area	0.9821	0.9662	0.9391	0.8763	0.7680	0.6094	0.4675	0.5162	0.7265	0.9069	0.9689	0.9849 (86)
Living	18.8068	19.1332	19.5733	20.1442	20.5902	20.8663	20.9583	20.9415	20.7520	20.1584	19.3984	18.7753
Non living	17.3671	17.7822	18.3375	19.0515	19.5727	19.8688	19.9447	19.9344	19.7669	19.0861	18.1349	17.3368
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	19.8781	19.1332	19.5733	20.1442	20.5902	20.8663	20.9583	20.9415	20.7520	20.1584	19.3984	19.0865 (87)
Th 2	19.9204	19.9244	19.9284	19.9485	19.9526	19.9647	19.9647	19.9647	19.9647	19.9526	19.9445	19.9364 (88)
util rest of house	0.9784	0.9595	0.9268	0.8510	0.7204	0.5323	0.3673	0.4142	0.6573	0.8823	0.9617	0.9819 (89)
MIT 2	18.9025	17.7822	18.3375	19.0515	19.5727	19.8688	19.9447	19.9344	19.7669	19.0861	18.1349	17.8052 (90)
Living area fraction	19.2055	18.2018	18.7213	19.3909	19.8887	20.1786	20.2595	20.2472	20.0728	19.4191	18.5273	18.2032 (92)
MIT	19.2055	18.2018	18.7213	19.3909	19.8887	20.1786	20.2595	20.2472	20.0728	19.4191	18.5273	18.2032 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2055	18.2018	18.7213	19.3909	19.8887	20.1786	20.2595	20.2472	20.0728	19.4191	18.5273	18.2032 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9755	0.9449	0.9090	0.8351	0.7172	0.5492	0.3969	0.4433	0.6652	0.8668	0.9482	0.9750 (94)
Useful gains	945.4735	1116.0112	1217.8003	1261.9717	1160.4893	882.6269	611.1202	634.3662	878.5704	986.8004	932.1084	891.8027 (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	2693.6185	2393.7678	2190.0992	1840.3955	1430.3551	961.7952	630.9295	663.2882	1029.7655	1540.4655	2013.3018	2488.2695 (97)
Space heating kWh	1300.6199	858.6524	723.3904	416.4652	200.7802	0.0000	0.0000	0.0000	0.0000	411.9268	778.4593	1187.7713 (98a)
Space heating requirement - total per year (kWh/year)												5878.0654
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	1300.6199	858.6524	723.3904	416.4652	200.7802	0.0000	0.0000	0.0000	0.0000	411.9268	778.4593	1187.7713 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5878.0654
Space heating per m <sup>2</sup>										(98c) / (4) =		39.0180 (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 %) 237.5000 (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	1300.6199	858.6524	723.3904	416.4652	200.7802	0.0000	0.0000	0.0000	0.0000	411.9268	778.4593	1187.7713 (98)
Space heating efficiency (main heating system 1)	237.5000	237.5000	237.5000	237.5000	237.5000	0.0000	0.0000	0.0000	0.0000	237.5000	237.5000	237.5000 (210)
Space heating fuel (main heating system)	547.6294	361.5379	304.5854	175.3538	84.5390	0.0000	0.0000	0.0000	0.0000	173.4429	327.7723	500.1142 (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	267.4724	236.3806	250.9387	220.4460	213.5141	192.2224	189.6911	197.3865	199.7121	222.8820	237.1865	264.5489 (64)
Efficiency of water heater (217)m	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000	237.5000 (216)
Fuel for water heating, kWh/month	112.6200	99.5287	105.6584	92.8193	89.9007	80.9358	79.8699	83.1101	84.0893	93.8450	99.8680	111.3890 (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	29.5868	26.7236	29.5868	28.6324	29.5868	28.6324	29.5868	29.5868	28.6324	29.5868	28.6324	29.5868 (231)
Lighting	33.6679	27.0096	24.3192	17.8173	13.7626	11.2441	12.5547	16.3190	21.1968	27.8114	31.4129	34.6036 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)

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Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											2474.9749	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											237.5000	
Water heating fuel used											1133.6342	(219)
Space cooling fuel											0.0000	(221)
Electricity for pumps and fans: (MEVCentralised, Table 4g: in-use factor = 2.5000, SFP = 2.0000) mechanical ventilation fans (SFP = 2.0000)											348.3613	(230a)
Total electricity for the above, kWh/year											348.3613	(231)
Electricity for lighting (calculated in Appendix L)											271.7191	(232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											0.0000	(233)
Wind generation											0.0000	(234)
Hydro-electric generation (Appendix N)											0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)											0.0000	(235)
Appendix Q - special features												
Energy saved or generated											-0.0000	(236)
Energy used											0.0000	(237)
Total delivered energy for all uses											4228.6895	(238)

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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	2474.9749	0.1554	384.5464	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1133.6342	0.1409	159.7319	(264)
Space and water heating			544.2784	(265)
Pumps, fans and electric keep-hot	348.3613	0.1387	48.3220	(267)
Energy for lighting	271.7191	0.1443	39.2175	(268)
Total CO2, kg/year			631.8178	(272)
Compliance Target Carbon Dioxide Emission Rate (TER)			4.1900	(273)
EPC Target Carbon Dioxide Emission Rate (TER)			4.1900	(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	2474.9749	1.5752	3898.5334	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1133.6342	1.5210	1724.2649	(278)
Space and water heating			5622.7984	(279)
Pumps, fans and electric keep-hot	348.3613	1.5128	527.0009	(281)
Energy for lighting	271.7191	1.5338	416.7719	(282)
Total Primary energy kWh/year			6566.5712	(286)
Compliance Target Delivered Energy Rate (TDER)			28.0700	(238)
EPC Target Delivered Energy Rate (TDER)			28.0700	(238)

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING  
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-----  
1. Overall dwelling characteristics  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )	
Ground floor	150.6500 (1b)	x 2.4300 (2b)	= 366.0795 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		= 366.0795 (4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 366.0795 (5)	

-----  
2. Ventilation rate  
-----

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



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Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 5.0000 (17)  
 Infiltration rate 0.2500 (18)  
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2500 (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 infiltr rate	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
Effective ac	0.5687	0.5625	0.5563	0.5250	0.5188	0.5000	0.5000	0.5000	0.5000	0.5188	0.5312	0.5437 (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
Half Glazed Door			4.2000	1.4000	5.8800		(26a)
Fully Glazed Door (Uw = 1.40)			8.4000	1.3258	11.1364		(27)
Windows (Uw = 1.40)			26.0700	1.3258	34.5625		(27)
Ground Floor			150.6500	0.1500	22.5975	110.0000	16571.5000 (28a)
Blockwork Walls	138.0000	38.6700	99.3300	0.1700	16.8861	9.0000	893.9700 (29a)
Ceiling Tie	150.6500		150.6500	0.1200	18.0780	9.0000	1355.8500 (30)
Total net area of external elements Aum(A, m2)			439.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 109.1405		(33)
Internal Partitions			300.5900			9.0000	2705.3100 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21526.6300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							142.8917 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	25.7000	0.0370	0.9509
E3 Sill	20.1000	0.0330	0.6633
E4 Jamb	45.4000	0.0310	1.4074
E5 Ground floor (normal)	56.7900	0.0970	5.5086
E10 Eaves (insulation at ceiling level)	40.5900	0.0430	1.7454
E12 Gable (insulation at ceiling level)	16.2000	0.0510	0.8262
E16 Corner (normal)	12.1500	0.0380	0.4617
E17 Corner (inverted - internal area greater than external area)	2.4300	0.0290	0.0705

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

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 120.7744 (37)

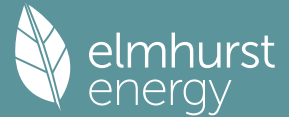
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	68.7085	67.9535	67.1985	63.4233	62.6682	60.4031	60.4031	60.4031	60.4031	62.6682	64.1783	65.6884 (38)
Average = Sum(39)m / 12 =	189.4830	188.7279	187.9729	184.1977	183.4427	181.1776	181.1776	181.1776	181.1776	183.4427	184.9527	186.4628 (39)
HLP	1.2578	1.2528	1.2477	1.2227	1.2177	1.2026	1.2026	1.2026	1.2026	1.2177	1.2277	1.2377 (40)
HLP (average)												1.2244
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													2.9352 (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	89.1701	87.8458	85.9809	82.5424	79.9677	77.1127	75.5706	77.4224	79.4388	82.4937	86.0030	88.8687	88.8687 (42b)
Hot water usage for other uses	47.0414	45.3308	43.6202	41.9096	40.1990	38.4884	38.4884	40.1990	41.9096	43.6202	45.3308	47.0414	47.0414 (42c)
Average daily hot water use (litres/day)													125.4397 (43)
Daily hot water use	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101	135.9101 (44)
Energy conte	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024	212.8024 (45)
Energy content (annual)													Total = Sum(45)m = 2083.1069
Distribution loss (46)m = 0.15 x (45)m	32.3589	28.4463	29.8788	25.5553	24.2651	21.3218	20.6917	21.8460	22.4452	25.6703	28.0664	31.9204	31.9204 (46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5800 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.2324 (55)
Total storage loss	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044 (56)
If cylinder contains dedicated solar storage	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	54.8576 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644	305.8644 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644	305.8644 (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 per year (kWh/year) = Sum(64)m =													3054.4945 (64)

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Heat gains from water heating, kWh/month  
 115.6149 102.6949 110.1175 99.1180 97.6738 65.2728 64.4765 67.0352 67.7631 100.7886 104.6842 114.6429 (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)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	57.3558	50.9429	41.4295	31.3648	23.4456	19.7937	21.3878	27.8007	37.3141	47.3788	55.2980	58.9499 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	479.4459	484.4210	471.8838	445.1936	411.5019	379.8366	358.6821	353.7070	366.2442	392.9344	426.6261	458.2915 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464 (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)	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079 (71)
Water heating gains (Table 5)	155.3964	152.8198	148.0074	137.6638	131.2819	90.6567	86.6619	90.1011	94.1155	135.4685	145.3947	154.0899 (72)
Total internal gains	806.4484	802.4341	775.5711	728.4726	680.4798	604.5374	580.9822	585.8591	611.9241	690.0321	741.5692	785.5816 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	8.4000	10.6334	0.7600	0.7000	0.7700	32.9303 (74)						
North	7.2600	10.6334	0.7600	0.7000	0.7700	28.4612 (74)						
South	13.4100	46.7521	0.7600	0.7000	0.7700	231.1396 (78)						
West	5.4000	19.6403	0.7600	0.7000	0.7700	39.1008 (80)						
Solar gains	331.6320	572.3590	807.5286	1048.9310	1224.4356	1238.8169	1184.5757	1049.1350	889.9166	638.7168	398.4678	283.0596 (83)
Total gains	1138.0804	1374.7932	1583.0997	1777.4036	1904.9155	1843.3543	1765.5580	1634.9941	1501.8407	1328.7490	1140.0370	1068.6411 (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)	31.5576	31.6838	31.8111	32.4631	32.5967	33.0042	33.0042	33.0042	33.0042	32.5967	32.3305	32.0687
tau	3.1038	3.1123	3.1207	3.1642	3.1731	3.2003	3.2003	3.2003	3.2003	3.1731	3.1554	3.1379
util living area	0.9728	0.9518	0.9139	0.8378	0.7169	0.5673	0.4314	0.4790	0.6880	0.8763	0.9557	0.9772 (86)
Living	19.2887	19.5435	19.8966	20.3177	20.6335	20.8134	20.8756	20.8639	20.7314	20.3142	19.7322	19.2565
Non living	17.8865	18.2096	18.6517	19.1763	19.5385	19.7316	19.7816	19.7747	19.6611	19.1885	18.4662	17.8571
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	20.1245	19.5435	19.8966	20.3177	20.6335	20.8134	20.8756	20.8639	20.7314	20.3142	19.7322	19.5004 (87)
Th 2	19.8741	19.8780	19.8820	19.9019	19.9059	19.9179	19.9179	19.9179	19.9179	19.9059	19.8979	19.8899 (88)
util rest of house	0.9674	0.9425	0.8974	0.8071	0.6647	0.4892	0.3333	0.3779	0.6148	0.8457	0.9457	0.9727 (89)
MIT 2	19.0817	18.2096	18.6517	19.1763	19.5385	19.7316	19.7816	19.7747	19.6611	19.1885	18.4662	18.2235 (90)
Living area fraction	19.4056	18.6239	19.0383	19.5308	19.8786	20.0676	20.1214	20.1130	fLA = Living area / (4) =			0.3106 (91)
MIT	19.4056	18.6239	19.0383	19.5308	19.8786	20.0676	20.1214	20.1130	19.9935	19.5381	18.8594	18.6201 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4056	18.6239	19.0383	19.5308	19.8786	20.0676	20.1214	20.1130	19.9935	19.5381	18.8594	18.6201 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9648	0.9294	0.8823	0.7953	0.6633	0.5006	0.3523	0.3970	0.6204	0.8334	0.9335	0.9659 (94)
Useful gains	1098.0096	1277.7752	1396.8453	1413.5436	1263.4855	922.8111	622.0937	649.0674	931.7196	1107.3967	1064.1933	1032.2470 (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	2862.2528	2590.0827	2356.8682	1958.1693	1500.2990	990.6058	637.9947	672.7196	1067.7780	1639.6329	2174.9338	2688.8058 (97)
Space heating kWh	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98a)
Space heating requirement - total per year (kWh/year)												5905.2411
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	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5905.2411
Space heating per m <sup>2</sup>												(98c) / (4) = 39.1984 (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 %)												388.2524 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (207)
												0.0000 (208)
Space heating requirement	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98)
Space heating efficiency (main heating system 1)	388.2524	388.2524	388.2524	388.2524	388.2524	0.0000	0.0000	0.0000	0.0000	388.2524	388.2524	388.2524 (210)

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Space heating fuel (main heating system)	338.0783	227.1385	183.9672	100.9989	45.3801	0.0000	0.0000	0.0000	0.0000	101.9913	205.9828	317.4429	(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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644	(64)
Efficiency of water heater (217)m	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	(216)
Fuel for water heating, kWh/month	173.4710	153.7581	164.1827	146.3038	143.1583	113.2713	112.0254	116.3486	117.4789	148.4210	155.7083	171.8287	(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	6.6299	5.9883	6.6299	6.4160	6.6299	6.4160	6.6299	6.4160	6.6299	6.4160	6.6299	6.4160	(231)
Lighting	50.2032	40.2749	36.2630	26.5679	20.5218	16.7665	18.7206	24.3338	31.6072	41.4704	46.8407	51.5985	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.2265	-110.5857	-155.6324	-168.6851	-175.8067	-154.1298	-152.5687	-145.6164	-132.0312	-121.8711	-85.9702	-68.4274	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1520.9801	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												178.0054	
Water heating fuel used												1715.9562	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 6.4670, total flow = 37.0000, SFP = 0.1748)													
mechanical ventilation fans (SFP = 0.1748)												78.0614	(230a)
Total electricity for the above, kWh/year												78.0614	(231)
Electricity for lighting (calculated in Appendix L)												405.1684	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1550.5511	(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												2169.6149	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1520.9801	16.4900	250.8096	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1715.9562	16.4900	282.9612	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	78.0614	16.4900	12.8723	(249)
Energy for lighting	405.1684	16.4900	66.8123	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5511	16.4900	-255.6859	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-255.6859	(252)
Total energy cost			357.7695	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		0.6583	(257)
SAP value		89.3289	
SAP rating (Section 12)		89	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1520.9801	0.1557	236.7463	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1715.9562	0.1416	242.9115	(264)
Space and water heating			479.6578	(265)
Pumps, fans and electric keep-hot	78.0614	0.1387	10.8281	(267)
Energy for lighting	405.1684	0.1443	58.4783	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5511	0.1356	-210.3050	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-210.3050	(269)
Total CO2, kg/year			338.6592	(272)

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CO2 emissions per m2 2.2500 (273)  
 EI value 97.6805  
 EI rating 98 (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	150.6500 (1b)	2.4300 (2b)	366.0795 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		366.0795 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 366.0795 (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		5.0000 (17)
Infiltration rate		0.2500 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000 (22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750 (22a)
Adj infilt rate	0.3563	0.3625	0.3563	0.3125	0.2875	0.2750	0.2500	0.2562	0.2875	0.3250	0.3312	0.3187 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
Effective ac	0.6062	0.6125	0.6062	0.5625	0.5375	0.5250	0.5000	0.5062	0.5375	0.5750	0.5813	0.5687 (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
Half Glazed Door			4.2000	1.4000	5.8800		(26a)
Fully Glazed Door (Uw = 1.40)			8.4000	1.3258	11.1364		(27)
Windows (Uw = 1.40)			26.0700	1.3258	34.5625		(28)
Ground Floor			150.6500	0.1500	22.5975	110.0000	16571.5000 (28a)
Blockwork Walls	138.0000	38.6700	99.3300	0.1700	16.8861	9.0000	893.9700 (29a)
Ceiling Tie	150.6500		150.6500	0.1200	18.0780	9.0000	1355.8500 (30)
Total net area of external elements Aum(A, m2)			439.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.1405	(32)
Internal Partitions			300.5900			9.0000	2705.3100 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 21526.6300 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 142.8917 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	25.7000	0.0370	0.9509
E3 Sill	20.1000	0.0330	0.6633
E4 Jamb	45.4000	0.0310	1.4074
E5 Ground floor (normal)	56.7900	0.0970	5.5086
E10 Eaves (insulation at ceiling level)	40.5900	0.0430	1.7454
E12 Gable (insulation at ceiling level)	16.2000	0.0510	0.8262
E16 Corner (normal)	12.1500	0.0380	0.4617
E17 Corner (inverted - internal area greater than external area)	2.4300	0.0290	0.0705

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.6340 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 120.7744 (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	73.2388	73.9938	73.2388	67.9535	64.9334	63.4233	60.4031	61.1582	64.9334	69.4636	70.2186	68.7085 (38)
Heat transfer coeff	194.0132	194.7683	194.0132	188.7279	185.7078	184.1977	181.1776	181.9326	185.7078	190.2380	190.9931	189.4830 (39)
Average = Sum(39)m / 12 =												188.4133

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2878	1.2929	1.2878	1.2528	1.2327	1.2227	1.2026	1.2077	1.2327	1.2628	1.2678	1.2578 (40)

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HLP (average) 1.2507  
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

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

Assumed occupancy												2.9352 (42)	
Hot water usage for mixer showers												0.0000 (42a)	
Hot water usage for baths												88.8687 (42b)	
Hot water usage for other uses												47.0414 (42c)	
Average daily hot water use (litres/day)												125.4397 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101	(44)
Distribution loss (46)m = 0.15 x (45)m	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024	(45)
Water storage loss:												2083.1069	
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.5800 (48)	
Temperature factor from Table 2b												0.7800 (49)	
Enter (49) or (54) in (55)												1.2324 (55)	
Total storage loss												38.2044 (56)	
If cylinder contains dedicated solar storage												38.2044 (57)	
Primary loss												54.8576 (59)	
Combi loss												0.0000 (61)	
Total heat required for water heating calculated for each month												305.8644 (62)	
WWHRS												0.0000 (63a)	
PV diverter												-0.0000 (63b)	
Solar input												0.0000 (63c)	
FGHRS												0.0000 (63d)	
Output from w/h												305.8644 (64)	
Electric shower(s)												0.0000 (64a)	
Heat gains from water heating, kWh/month												114.6429 (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	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												21.3878 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												358.6821 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												55.5464 (69)	
Pumps, fans												0.0000 (70)	
Losses e.g. evaporation (negative values) (Table 5)												-117.4079 (71)	
Water heating gains (Table 5)												155.3964 (72)	
Total internal gains												806.4484 (73)	

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access Factor Table 6d	Gains W							
North	8.4000	8.2005	0.7600	0.7000	0.7700	25.3960 (74)							
North	7.2600	8.2005	0.7600	0.7000	0.7700	21.9494 (74)							
South	13.4100	38.1750	0.7600	0.7000	0.7700	188.7350 (78)							
West	5.4000	14.7869	0.7600	0.7000	0.7700	29.4386 (80)							
Solar gains	265.5189	520.7718	806.8736	1053.9119	1279.3261	1194.3219	1141.7790	1005.6936	835.4257	568.4756	330.5566	206.7880	(83)
Total gains	1071.9673	1323.2059	1582.4447	1782.3845	1959.8059	1798.8593	1722.7612	1591.5527	1447.3498	1258.5077	1072.1258	992.3696	(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	30.8207	30.7012	30.8207	31.6838	32.1991	32.4631	33.0042	32.8672	32.1991	31.4323	31.3080	31.5576	(86)
alpha	3.0547	3.0467	3.0547	3.1123	3.1466	3.1642	3.2003	3.1911	3.1466	3.0955	3.0872	3.1038	
util living area	0.9802	0.9645	0.9331	0.8790	0.7964	0.7189	0.6355	0.6769	0.8104	0.9250	0.9709	0.9848	(86)
Living	19.0465	19.2587	19.6339	20.0721	20.4195	20.6436	20.7659	20.7333	20.5090	19.9954	19.4300	18.9790	
Non living	17.5621	17.8273	18.3005	18.8609	19.2853	19.5485	19.6897	19.6572	19.4034	18.7740	18.0619	17.4924	
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	20.0006	19.2587	19.6339	20.0721	20.4195	20.6436	20.7659	20.7333	20.5090	19.9954	19.4300	19.2617	(87)
Th 2	19.8504	19.8464	19.8504	19.8780	19.8939	19.9019	19.9179	19.9139	19.8939	19.8701	19.8661	19.8741	(88)

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util rest of house	0.9764	0.9579	0.9207	0.8569	0.7603	0.6634	0.5627	0.6054	0.7637	0.9069	0.9645	0.9819 (89)
MIT 2	18.9381	17.8273	18.3005	18.8609	19.2853	19.5485	19.6897	19.6572	19.4034	18.7740	18.0619	17.9216 (90)
Living area fraction									FLA =	Living area / (4) =		0.3106 (91)
MIT	19.2681	18.2719	18.7147	19.2371	19.6376	19.8887	20.0240	19.9914	19.7468	19.1533	18.4868	18.3378 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2681	18.2719	18.7147	19.2371	19.6376	19.8887	20.0240	19.9914	19.7468	19.1533	18.4868	18.3378 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9741	0.9462	0.9057	0.8421	0.7509	0.6627	0.5704	0.6110	0.7565	0.8926	0.9542	0.9767 (94)	
Useful gains	1044.1871	1252.0018	1433.1737	1500.9144	1471.7156	1192.0943	982.5948	972.4009	1094.9830	1123.3518	1023.0683	969.2122 (95)	
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000 (96)	
Heat loss rate W	3098.0260	2857.6137	2660.8273	2290.6029	1919.7650	1416.2318	1091.4050	1108.2255	1438.6386	1969.5991	2442.1941	2925.1982 (97)	
Space heating kWh	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535 (98a)	
Space heating requirement - total per year (kWh/year)												7528.9582	
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	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												7528.9582	
Space heating per m2										(98c) / (4) =		49.9765 (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 %)													388.7458 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535 (98)	
Space heating efficiency (main heating system 1)	388.7458	388.7458	388.7458	388.7458	388.7458	0.0000	0.0000	0.0000	0.0000	388.7458	388.7458	388.7458 (210)	
Space heating fuel (main heating system)	393.0734	277.5519	234.9541	146.2590	85.7498	0.0000	0.0000	0.0000	0.0000	161.9588	262.8377	374.3458 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (64)	
Efficiency of water heater (217)m	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183 (216)	
Fuel for water heating, kWh/month	173.4584	153.7470	164.1708	146.2931	143.1479	113.2631	112.0173	116.3401	117.4703	148.4102	155.6970	171.8162 (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	6.6299	5.9883	6.6299	6.4160	6.6299	6.4160	6.6299	6.4160	6.6299	6.4160	6.6299	6.6299 (231)	
Lighting	50.2032	40.2749	36.2630	26.5679	20.5218	16.7665	18.7206	24.3338	31.6072	41.4704	46.8407	51.5985 (232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-65.4671	-103.2573	-157.6278	-173.8161	-186.6397	-151.9913	-150.3758	-142.6203	-126.8920	-114.3620	-74.1870	-52.1197 (233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)	
Annual totals kWh/year													
Space heating fuel - main system 1													1936.7306 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													178.0183
Water heating fuel used													1715.8315 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.4670, total flow = 37.0000, SFP = 0.1748) mechanical ventilation fans (SFP = 0.1748)													78.0614 (230a)
Total electricity for the above, kWh/year													78.0614 (231)
Electricity for lighting (calculated in Appendix L)													405.1684 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1499.3561 (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													2636.4358 (238)

## 10a. Fuel costs - using BEDF prices (538)

# Full SAP Calculation Printout



	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1936.7306	25.1600	487.2814 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1715.8315	25.1600	431.7032 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	78.0614	25.1600	19.6403 (249)
Energy for lighting	405.1684	25.1600	101.9404 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1499.3561	25.1600	-377.2380
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-377.2380 (252)
Total energy cost			663.3273 (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	1936.7306	0.1546	299.3945 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1715.8315	0.1416	242.8939 (264)
Space and water heating			542.2884 (265)
Pumps, fans and electric keep-hot	78.0614	0.1387	10.8281 (267)
Energy for lighting	405.1684	0.1443	58.4783 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1499.3561	0.1350	-202.4374
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-202.4374 (269)
Total CO2, kg/year			409.1573 (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	1936.7306	1.5723	3045.0760 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1715.8315	1.5235	2614.0462 (278)
Space and water heating			5659.1223 (279)
Pumps, fans and electric keep-hot	78.0614	1.5128	118.0913 (281)
Energy for lighting	405.1684	1.5338	621.4608 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1499.3561	1.4991	-2247.6215
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-2247.6215 (283)
Total Primary energy kWh/year			4151.0529 (286)

## SAP 10 EPC IMPROVEMENTS

00001

	Recommended	Already installed	Recommended
N Solar water heating			
U Solar photovoltaic panels			
V2 Wind turbine			
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 51	-25 kg (6.2%)
V2 Wind turbine	+ 12.3	-£ 630	-347 kg (90.4%)

Current energy efficiency rating: B 89  
 Current environmental impact rating: A 98

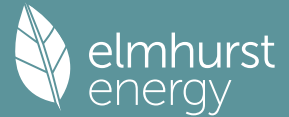
Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£51	0.17 kg/m <sup>2</sup>	B 90	A 98
Wind turbine	£630	2.30 kg/m <sup>2</sup>	A 103	A 100
<b>Total Savings</b>	<b>£681</b>	<b>2.47 kg/m<sup>2</sup></b>		

Potential energy efficiency rating: A 103  
 Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 538 TEST (29 Feb 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, North East Scotland):			
	Current	Potential	Saving
Electricity	£1041	£979	£62
Space heating	£507	£527	-£20
Water heating	£432	£350	£82
Lighting	£102	£102	£0
Generated (PV)	-£377	-£367	-£10
Generated (wind)	-£0	-£630	£630
<b>Total cost of fuels</b>	<b>£664</b>	<b>-£18</b>	<b>£682</b>
<b>Total cost of uses</b>	<b>£664</b>	<b>-£18</b>	<b>£682</b>
Delivered energy	18 kWh/m <sup>2</sup>	-0 kWh/m <sup>2</sup>	18 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.4 tonnes	0.0 tonnes	0.4 tonnes
CO2 emissions per m <sup>2</sup>	3 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	28 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>	27 kWh/m <sup>2</sup>

# Full SAP Calculation Printout



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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	150.6500 (1b)	x 2.4300 (2b)	= 366.0795 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 366.0795 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2500 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500 (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 infiltr rate	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
Effective ac	0.5687	0.5625	0.5563	0.5250	0.5188	0.5000	0.5000	0.5000	0.5000	0.5188	0.5312	0.5437 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Half Glazed Door			4.2000	1.4000	5.8800		(26a)
Fully Glazed Door (Uw = 1.40)			8.4000	1.3258	11.1364		(27)
Windows (Uw = 1.40)			26.0700	1.3258	34.5625		(27)
Ground Floor			150.6500	0.1500	22.5975	110.0000	16571.5000 (28a)
Blockwork Walls	138.0000	38.6700	99.3300	0.1700	16.8861	9.0000	893.9700 (29a)
Ceiling Tie	150.6500		150.6500	0.1200	18.0780	9.0000	1355.8500 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			439.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.1405	(33)
Internal Partitions			300.5900				9.0000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							21526.6300 (34)
List of Thermal Bridges							142.8917 (35)

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	25.7000	0.0370	0.9509
E3 Sill	20.1000	0.0330	0.6633
E4 Jamb	45.4000	0.0310	1.4074
E5 Ground floor (normal)	56.7900	0.0970	5.5086
E10 Eaves (insulation at ceiling level)	40.5900	0.0430	1.7454
E12 Gable (insulation at ceiling level)	16.2000	0.0510	0.8262
E16 Corner (normal)	12.1500	0.0380	0.4617
E17 Corner (inverted - internal area greater than external area)	2.4300	0.0290	0.0705
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.6340 (36)
Point Thermal bridges			0.0000 (36a)
Total fabric heat loss			(33) + (36) + (36a) = 120.7744 (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	68.7085	67.9535	67.1985	63.4233	62.6682	60.4031	60.4031	60.4031	60.4031	62.6682	64.1783	65.6884 (38)
Heat transfer coeff	189.4830	188.7279	187.9729	184.1977	183.4427	181.1776	181.1776	181.1776	181.1776	183.4427	184.9527	186.4628 (39)
Average = Sum(39)m / 12 =												184.4494
HLP	1.2578	1.2528	1.2477	1.2227	1.2177	1.2026	1.2026	1.2026	1.2026	1.2177	1.2277	1.2377 (40)
HLP (average)												1.2244
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												2.9352 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	89.1701	87.8458	85.9809	82.5424	79.9677	77.1127	75.5706	77.4224	79.4388	82.4937	86.0030	88.8687 (42b)
Hot water usage for other uses	47.0414	45.3308	43.6202	41.9096	40.1990	38.4884	38.4884	40.1990	41.9096	43.6202	45.3308	47.0414 (42c)
Average daily hot water use (litres/day)												125.4397 (43)
Daily hot water use	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101 (44)
Energy content (annual)	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024 (45)
Distribution loss (46)m = 0.15 x (45)m												2083.1069
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5800 (48)
Temperature factor from Table 2b												0.7800 (49)
Enter (49) or (54) in (55)												1.2324 (55)
Total storage loss	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (56)
If cylinder contains dedicated solar storage	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (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												640.3963 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												640.3963
Solar input	-0.0000	-16.1820	-59.3174	-82.9291	-110.7429	-99.3268	-98.8854	-85.7931	-58.3790	-28.8405	-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	308.7878	257.5157	232.9367	177.4995	144.0866	102.3023	100.5259	121.3137	150.7397	235.3568	277.1691	305.8644 (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	115.6149	102.6949	110.1175	99.1180	97.6738	65.2728	64.4765	67.0352	67.7631	100.7886	104.6842	114.6429 (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	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	57.3558	50.9429	41.4295	31.3648	23.4456	19.7937	21.3878	27.8007	37.3141	47.3788	55.2980	58.9499 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	479.4459	484.4210	471.8838	445.1936	411.5019	379.8366	358.6821	353.7070	366.2442	392.9344	426.6261	458.2915 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464 (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)	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079 (71)
Water heating gains (Table 5)	155.3964	152.8198	148.0074	137.6638	131.2819	90.6567	86.6619	90.1011	94.1155	135.4685	145.3947	154.0899 (72)
Total internal gains	806.4484	802.4341	775.5711	728.4726	680.4798	604.5374	580.9822	585.8591	611.9241	690.0321	741.5692	785.5816 (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	8.4000	10.6334	0.7600	0.7000	0.7700	32.9303 (74)						
North	7.2600	10.6334	0.7600	0.7000	0.7700	28.4612 (74)						
South	13.4100	46.7521	0.7600	0.7000	0.7700	231.1396 (78)						
West	5.4000	19.6403	0.7600	0.7000	0.7700	39.1008 (80)						
Solar gains	331.6320	572.3590	807.5286	1048.9310	1224.4356	1238.8169	1184.5757	1049.1350	889.9166	638.7168	398.4678	283.0596 (83)
Total gains	1138.0804	1374.7932	1583.0997	1777.4036	1904.9155	1843.3543	1765.5580	1634.9941	1501.8407	1328.7490	1140.0370	1068.6411 (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	31.5576	31.6838	31.8111	32.4631	32.5967	33.0042	33.0042	33.0042	33.0042	32.5967	32.3305	32.0687
alpha	3.1038	3.1123	3.1207	3.1642	3.1731	3.2003	3.2003	3.2003	3.2003	3.1731	3.1554	3.1379

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util living area	0.9728	0.9518	0.9139	0.8378	0.7169	0.5673	0.4314	0.4790	0.6880	0.8763	0.9557	0.9772 (86)
Living	19.2887	19.5435	19.8966	20.3177	20.6335	20.8134	20.8756	20.8639	20.7314	20.3142	19.7322	19.2565
Non living	17.8865	18.2096	18.6517	19.1763	19.5385	19.7316	19.7816	19.7747	19.6611	19.1885	18.4662	17.8571
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	20.1245	19.5435	19.8966	20.3177	20.6335	20.8134	20.8756	20.8639	20.7314	20.3142	19.7322	19.5004 (87)
Th 2	19.8741	19.8780	19.8820	19.9019	19.9059	19.9179	19.9179	19.9179	19.9179	19.9059	19.8979	19.8899 (88)
util rest of house												
MIT 2	0.9674	0.9425	0.8974	0.8071	0.6647	0.4892	0.3333	0.3779	0.6148	0.8457	0.9457	0.9727 (89)
Living area fraction	19.0817	18.2096	18.6517	19.1763	19.5385	19.7316	19.7816	19.7747	19.6611	19.1885	18.4662	18.2235 (90)
MIT	19.4056	18.6239	19.0383	19.5308	19.8786	20.0676	20.1214	20.1130	19.9935	19.5381	18.8594	18.6201 (91)
Temperature adjustment												0.0000
adjusted MIT	19.4056	18.6239	19.0383	19.5308	19.8786	20.0676	20.1214	20.1130	19.9935	19.5381	18.8594	18.6201 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9648	0.9294	0.8823	0.7953	0.6633	0.5006	0.3523	0.3970	0.6204	0.8334	0.9335	0.9659 (94)
Useful gains	1098.0006	1277.7752	1396.8453	1413.5436	1263.4855	922.8111	622.0937	649.0674	931.7196	1107.3967	1064.1933	1032.2470 (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	2862.2528	2590.0827	2356.8682	1958.1693	1500.2990	990.6058	637.9947	672.7196	1067.7780	1639.6329	2174.9338	2688.8058 (97)
Space heating kWh	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98a)
Space heating requirement - total per year (kWh/year)												5905.2411
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	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5905.2411
Space heating per m2												39.1984 (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 %)												388.2524 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1312.5969	881.8707	714.2571	392.1305	176.1892	0.0000	0.0000	0.0000	0.0000	395.9838	799.7332	1232.4797 (98)
Space heating efficiency (main heating system 1)	388.2524	388.2524	388.2524	388.2524	388.2524	0.0000	0.0000	0.0000	0.0000	388.2524	388.2524	388.2524 (210)
Space heating fuel (main heating system)	338.0783	227.1385	183.9672	100.9989	45.3801	0.0000	0.0000	0.0000	0.0000	101.9913	205.9828	317.4429 (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	308.7878	257.5157	232.9367	177.4995	144.0866	102.3023	100.5259	121.3137	150.7397	235.3568	277.1691	305.8644 (64)
Efficiency of water heater (217)m	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054	178.0054 (216)
Fuel for water heating, kWh/month	173.4710	144.6674	130.8594	99.7158	80.9451	57.4715	56.4735	68.1517	84.6827	132.2189	155.7083	171.8287 (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	13.4244	12.1253	13.4244	12.9913	13.4244	12.9913	13.4244	13.4244	12.9913	13.4244	12.9913	13.4244 (231)
Lighting	50.2032	40.2749	36.2630	26.5679	20.5218	16.7665	18.7206	24.3338	31.6072	41.4704	46.8407	51.5985 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.3267	-110.4793	-153.8486	-164.1035	-166.7450	-144.2015	-142.6968	-138.2830	-128.4032	-121.2705	-86.1350	-68.5117 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1520.9801 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												178.0054
Water heating fuel used												1356.1939 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 6.4670, total flow = 37.0000, SFP = 0.1748)												
mechanical ventilation fans (SFP = 0.1748)												78.0614 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												158.0614 (231)
Electricity for lighting (calculated in Appendix L)												405.1684 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1504.0046 (233)
Wind generation												-3575.5408 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)

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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	-566.4794 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1520.9801	16.4900	250.8096 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1356.1939	16.4900	223.6364 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (249)
Pumps, fans and electric keep-hot	78.0614	16.4900	12.8723 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	405.1684	16.4900	66.8123 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1504.0046	16.4900	-248.0104
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-248.0104 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	0.0000	5.5900	0.0000
Total			-412.7247 (252)
Total energy cost			-93.4125 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] = -0.1719 (257)$
SAP value	102.7862
SAP rating (Section 12)	103 (258)
SAP band	A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1520.9801	0.1557	236.7463 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1356.1939	0.1453	197.0194 (264)
Space and water heating			433.7657 (265)
Pumps, fans and electric keep-hot	158.0614	0.1387	21.9251 (267)
Energy for lighting	405.1684	0.1443	58.4783 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1504.0046	0.1360	-204.5859
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-204.5859 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			-37.5969 (272)
CO2 emissions per m2			-0.2500 (273)
EI value			100.2575
EI rating			100 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	150.6500 (1b)	x 2.4300 (2b)	= 366.0795 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.6500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 366.0795 (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

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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													5.0000 (17)
Infiltration rate													0.2500 (18)
Number of sides sheltered													0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.2500 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000 (22)	
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750 (22a)	
Adj infilt rate	0.3563	0.3625	0.3563	0.3125	0.2875	0.2750	0.2500	0.2562	0.2875	0.3250	0.3312	0.3187 (22b)	
Mechanical extract ventilation - decentralised													0.5000 (23a)
If mechanical ventilation													0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23a)
Effective ac	0.6062	0.6125	0.6062	0.5625	0.5375	0.5250	0.5000	0.5062	0.5375	0.5750	0.5813	0.5687 (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
Half Glazed Door			4.2000	1.4000	5.8800		(26a)
Fully Glazed Door (Uw = 1.40)			8.4000	1.3258	11.1364		(27)
Windows (Uw = 1.40)			26.0700	1.3258	34.5625		(27)
Ground floor			150.6500	0.1500	22.5975	110.0000	16571.5000 (28a)
Blockwork Walls	138.0000	38.6700	99.3300	0.1700	16.8861	9.0000	893.9700 (29a)
Ceiling Tie	150.6500		150.6500	0.1200	18.0780	9.0000	1355.8500 (30)
Total net area of external elements Aum(A, m2)			439.3000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	109.1405			(33)
Internal Partitions			300.5900			9.0000	2705.3100 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				21526.6300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							142.8917 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	25.7000	0.0370	0.9509
E3 Sill	20.1000	0.0330	0.6633
E4 Jamb	45.4000	0.0310	1.4074
E5 Ground floor (normal)	56.7900	0.0970	5.5086
E10 Eaves (insulation at ceiling level)	40.5900	0.0430	1.7454
E12 Gable (insulation at ceiling level)	16.2000	0.0510	0.8262
E16 Corner (normal)	12.1500	0.0380	0.4617
E17 Corner (inverted - internal area greater than external area)	2.4300	0.0290	0.0705
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.6340 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 120.7744 (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	73.2388	73.9938	73.2388	67.9535	64.9334	63.4233	60.4031	61.1582	64.9334	69.4636	70.2186	68.7085 (38)
Average = Sum(39)m / 12 =	194.0132	194.7683	194.0132	188.7279	185.7078	184.1977	181.1776	181.9326	185.7078	190.2380	190.9931	189.4830 (39)
HLP	1.2878	1.2929	1.2878	1.2528	1.2327	1.2227	1.2026	1.2077	1.2327	1.2628	1.2678	1.2578 (40)
HLP (average)												1.2507
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9352 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	89.1701	87.8458	85.9809	82.5424	79.9677	77.1127	75.5706	77.4224	79.4388	82.4937	86.0030	88.8687 (42b)
Hot water usage for other uses	47.0414	45.3308	43.6202	41.9096	40.1990	38.4884	38.4884	40.1990	41.9096	43.6202	45.3308	47.0414 (42c)
Average daily hot water use (litres/day)												125.4397 (43)
Daily hot water use	136.2115	133.1766	129.6012	124.4520	120.1667	115.6011	114.0590	117.6215	121.3484	126.1139	131.3338	135.9101 (44)
Energy conte	215.7258	189.6418	199.1922	170.3686	161.7675	142.1451	137.9445	145.6400	149.6347	171.1354	187.1091	212.8024 (45)
Energy content (annual)												Total = Sum(45)m = 2083.1069
Distribution loss (46)m = 0.15 x (45)m	32.3589	28.4463	29.8788	25.5553	24.2651	21.3218	20.6917	21.8460	22.4452	25.6703	28.0664	31.9204 (46)
Water storage loss:												210.0000 (47)
Store volume												1.5800 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.7800 (49)
Temperature factor from Table 2b												1.2324 (55)
Enter (49) or (54) in (55)												
Total storage loss	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (56)
If cylinder contains dedicated solar storage	38.2044	34.5072	38.2044	36.9720	38.2044	36.9720	38.2044	38.2044	36.9720	38.2044	36.9720	38.2044 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	308.7878	273.6978	292.2542	260.4286	254.8295	201.6291	199.4113	207.1068	209.1187	264.1974	277.1691	305.8644 (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)

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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												578.2671 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												578.2671
Solar input	-0.0000	-7.8691	-54.5644	-79.2861	-112.5905	-91.9707	-91.0397	-76.8311	-48.0489	-16.0666	-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	308.7878	265.8286	237.6898	181.1425	142.2389	109.6583	108.3716	130.2757	161.0698	248.1308	277.1691	305.8644 (64)
												Total per year (kWh/year) = Sum(64)m = 2476.2275 (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	115.6149	102.6949	110.1175	99.1180	97.6738	65.2728	64.4765	67.0352	67.7631	100.7886	104.6842	114.6429 (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	
	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	176.1119	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.3558	50.9429	41.4295	31.3648	23.4456	19.7937	21.3878	27.8007	37.3141	47.3788	55.2980	58.9499	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	479.4459	484.4210	471.8838	445.1936	411.5019	379.8366	358.6821	353.7070	366.2442	392.9344	426.6261	458.2915	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	55.5464	(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)													
	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	-117.4079	(71)
Water heating gains (Table 5)													
	155.3964	152.8198	148.0074	137.6638	131.2819	90.6567	86.6619	90.1011	94.1155	135.4685	145.3947	154.0899	(72)
Total internal gains													
	806.4484	802.4341	775.5711	728.4726	680.4798	604.5374	580.9822	585.8591	611.9241	690.0321	741.5692	785.5816	(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		8.4000	8.2005	0.7600	0.7000	0.7700	25.3960 (74)					
North		7.2600	8.2005	0.7600	0.7000	0.7700	21.9494 (74)					
South		13.4100	38.1750	0.7600	0.7000	0.7700	188.7350 (78)					
West		5.4000	14.7869	0.7600	0.7000	0.7700	29.4386 (80)					
Solar gains	265.5189	520.7718	806.8736	1053.9119	1279.3261	1194.3219	1141.7790	1005.6936	835.4257	568.4756	330.5566	206.7880 (83)
Total gains	1071.9673	1323.2059	1582.4447	1782.3845	1959.8059	1798.8593	1722.7612	1591.5527	1447.3498	1258.5077	1072.1258	992.3696 (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	30.8207	30.7012	30.8207	31.6838	32.1991	32.4631	33.0042	32.8672	32.1991	31.4323	31.3080	31.5576
alpha	3.0547	3.0467	3.0547	3.1123	3.1466	3.1642	3.2003	3.1911	3.1466	3.0955	3.0872	3.1038
util living area	0.9802	0.9645	0.9331	0.8790	0.7964	0.7189	0.6355	0.6769	0.8104	0.9250	0.9709	0.9848 (86)
Living	19.0465	19.2587	19.6339	20.0721	20.4195	20.6436	20.7659	20.7333	20.5090	19.9954	19.4300	18.9790
Non living	17.5621	17.8273	18.3005	18.8609	19.2853	19.5485	19.6897	19.6572	19.4034	18.7740	18.0619	17.4924
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	20.0006	19.2587	19.6339	20.0721	20.4195	20.6436	20.7659	20.7333	20.5090	19.9954	19.4300	19.2617 (87)
Th 2	19.8504	19.8464	19.8504	19.8780	19.8939	19.9019	19.9179	19.9139	19.8939	19.8701	19.8661	19.8741 (88)
util rest of house	0.9764	0.9579	0.9207	0.8569	0.7603	0.6634	0.5627	0.6054	0.7637	0.9069	0.9645	0.9819 (89)
MIT 2	18.9381	17.8273	18.3005	18.8609	19.2853	19.5485	19.6897	19.6572	19.4034	18.7740	18.0619	17.9216 (90)
Living area fraction										FLA = Living area / (4) = 0.3106 (91)		
MIT	19.2681	18.2719	18.7147	19.2371	19.6376	19.8887	20.0240	19.9914	19.7468	19.1533	18.4868	18.3378 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2681	18.2719	18.7147	19.2371	19.6376	19.8887	20.0240	19.9914	19.7468	19.1533	18.4868	18.3378 (93)

## 8. Space heating requirement

Utilisation	0.9741	0.9462	0.9057	0.8421	0.7509	0.6627	0.5704	0.6110	0.7565	0.8926	0.9542	0.9767 (94)
Useful gains	1044.1871	1252.0018	1433.1737	1500.9144	1471.7156	1192.0943	982.5948	972.4009	1094.9830	1123.3518	1023.0683	969.2122 (95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000 (96)
Heat loss rate W	3098.0260	2857.6137	2660.8273	2290.6029	1919.7650	1416.2318	1091.4050	1108.2255	1438.6386	1969.5991	2442.1941	2925.1982 (97)
Space heating kWh	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535 (98a)
Space heating requirement - total per year (kWh/year)												7528.9582
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	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7528.9582
Space heating per m2												(98c) / (4) = 49.9765 (99)

# Full SAP Calculation Printout



## 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 %)													388.7458 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	1528.0561	1078.9712	913.3743	568.5757	333.3488	0.0000	0.0000	0.0000	0.0000	629.6080	1021.7706	1455.2535	(98)
Space heating efficiency (main heating system 1)	388.7458	388.7458	388.7458	388.7458	388.7458	0.0000	0.0000	0.0000	0.0000	388.7458	388.7458	388.7458	(210)
Space heating fuel (main heating system)	393.0734	277.5519	234.9541	146.2590	85.7498	0.0000	0.0000	0.0000	0.0000	161.9588	262.8377	374.3458	(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	308.7878	265.8286	237.6898	181.1425	142.2389	109.6583	108.3716	130.2757	161.0698	248.1308	277.1691	305.8644	(64)
Efficiency of water heater (217)m	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	178.0183	(216)
Fuel for water heating, kWh/month	173.4584	149.3266	133.5198	101.7550	79.9013	61.5995	60.8767	73.1811	90.4794	139.3849	155.6970	171.8162	(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	13.4244	12.1253	13.4244	12.9913	13.4244	12.9913	13.4244	13.4244	12.9913	13.4244	12.9913	13.4244	(231)
Lighting	50.2032	40.2749	36.2630	26.5679	20.5218	16.7665	18.7206	24.3338	31.6072	41.4704	46.8407	51.5985	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-65.5344	-103.3067	-156.1678	-169.7994	-177.6526	-143.1978	-141.7064	-136.4780	-124.2912	-114.2543	-74.3016	-52.1691	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													1936.7306 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													178.0183 (216)
Water heating fuel used													1390.9958 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (MEVDecentralised, Database: total watage = 6.4670, total flow = 37.0000, SFP = 0.1748)													78.0614 (230a)
mechanical ventilation fans (SFP = 0.1748)													80.0000 (230g)
pump for solar water heating													158.0614 (231)
Total electricity for the above, kWh/year													405.1684 (232)
Electricity for lighting (calculated in Appendix L)													
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1458.8594 (233)
Wind generation													-3575.5408 (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													-70.7817 (238)

## 10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1936.7306	25.1600	487.2814	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1390.9958	25.1600	349.9745	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	78.0614	25.1600	19.6403	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	405.1684	25.1600	101.9404	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1458.8594	25.1600	-367.0490	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-367.0490	(252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242	
Wind Turbine electricity exported	0.0000	5.8100	0.0000	
Total			-629.7242	(252)
Total energy cost			-17.8087	(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	1936.7306	0.1546	299.3945	(261)
Total CO2 associated with community systems			0.0000	(373)

# Full SAP Calculation Printout



Water heating (other fuel)	1390.9958	0.1449	201.5491 (264)
Space and water heating			500.9436 (265)
Pumps, fans and electric keep-hot	158.0614	0.1387	21.9251 (267)
Energy for lighting	405.1684	0.1443	58.4783 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1458.8594	0.1354	-197.4602
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-197.4602 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			36.7067 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1936.7306	1.5723	3045.0760 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1390.9958	1.5360	2136.5295 (278)
Space and water heating			5181.6055 (279)
Pumps, fans and electric keep-hot	158.0614	1.5128	239.1153 (281)
Energy for lighting	405.1684	1.5338	621.4608 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1458.8594	1.5003	-2188.7624
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-2188.7624 (283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-3786.3546 (283)
Total Primary energy kWh/year			67.0645 (286)

# Summary for Input Data



Property Reference	0224/06-Clubb		Issued on Date	06/03/2024	
Assessment Reference	00001	Prop Type Ref			
Property	Land South of Lochhead Cottage, Rora, Aberdeenshire				
SAP Rating	89 B	DER	2.32	TER	4.19
Environmental	98 A	% DER < TER			N/A
CO <sub>2</sub> Emissions (t/year)	0.41	DDER	14.84	TDER	28.07
Compliance Check	See Compliance Report	% DDER < TDER			47.13
Assessor Details	Mr. Colin Thompson			Assessor ID	E355-0002
Client	Brian Clubb, Brian Clubb				

## SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South
Property Tenure	1
Transaction Type	6
Terrain Type	Rural
1.0 Property Type	Bungalow, Detached
2.0 Number of Storeys	1
3.0 Date Built	2024
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Precise calculation
7.0 Electricity Tariff	Standard
Smart electricity meter fitted	Yes
Smart gas meter fitted	Yes

7.0 Measurements	Ground floor:	Heat Loss Perimeter 56.79 m	Internal Floor Area 150.65 m <sup>2</sup>	Average Storey Height 2.43 m
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8.0 Living Area	46.79	m <sup>2</sup>
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9.0 External Walls										
Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Res	Shelter	Openings	Area Calculation Type
Blockwork Walls	Timber Frame	Timber framed wall (one layer of plasterboard)	0.17	9.00	138.00	99.33	0.00	None	38.67	Enter Gross Area

9.2 Internal Walls					
Description	Construction			Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Partitions	Plasterboard on timber frame			9.00	300.59

10.0 External Roofs										
Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Code	Shelter Factor	Calculation Type	Openings
Ceiling Tie	External Plane Roof	Plasterboard, insulated at ceiling level	0.12	9.00	150.65	150.65	None	0.00	Enter Gross Area	0.00

11.0 Heat Loss Floors										
Description	Type	Storey Index	Construction	U-Value (W/m <sup>2</sup> K)	Shelter Code	Shelter Factor	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )		
Ground Floor	Ground Floor - Solid	Lowest occupied	Slab on ground, screed over insulation	0.15	None	0.00	0.00	150.65		

12.0 Opening Types										
Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)	
Half Glazed Door	Manufacturer	Half Glazed Door	Double glazed			0.76		0.70	1.40	
Fully Glazed Door	Manufacturer	Window	Double glazed			0.76		0.70	1.40	
Windows	Manufacturer	Window	Double glazed			0.76		0.70	1.40	

13.0 Openings					
Name	Opening Type	Location	Orientation	Area (m <sup>2</sup> )	Pitch
N Door (Half Glazed)	Half Glazed Door	Blockwork Walls	North	2.10	
S Door (Half Glazed)	Half Glazed Door	Blockwork Walls	South	2.10	
N Door (Fully Glazed)	Fully Glazed Door	Blockwork Walls	North	8.40	
N Windows	Windows	Blockwork Walls	North	7.26	



# Summary for Input Data



S Windows      Windows      Blockwork Walls      South      13.41  
 W Windows      Windows      Blockwork Walls      West      5.40

**14.0 Conservatory**

None

**15.0 Draught Proofing**

100 %

**16.0 Draught Lobby**

Yes

**17.0 Thermal Bridging**

Calculate Bridges

**17.1 List of Bridges**

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Scotland ACD 2015	25.70	0.04	0.04	No
E3 Sill	Scotland ACD 2015	20.10	0.03	0.03	No
E4 Jamb	Scotland ACD 2015	45.40	0.03	0.03	No
E5 Ground floor (normal)	Scotland ACD 2015	56.79	0.10	0.10	No
E10 Eaves (insulation at ceiling level)	Scotland ACD 2015	40.59	0.04	0.04	No
E12 Gable (insulation at ceiling level)	Scotland ACD 2015	16.20	0.05	0.05	No
E16 Corner (normal)	Scotland ACD 2015	12.15	0.04	0.04	No
E17 Corner (inverted – internal area greater than external area)	Scotland ACD 2015	2.43	0.03	0.03	No

Y-value      0.03      W/m²K

**18.0 Pressure Testing**

Yes

Designed AP<sub>50</sub>      5.00      m²/(h.m²) @ 50 Pa

Test Method      Blower Door

**19.0 Mechanical Ventilation**

**Mechanical Ventilation**

Mechanical Ventilation System Present      Yes

Approved Installation      No

Mechanical Ventilation data Type      Database

Type      Mechanical extract ventilation - decentralised

MV Reference Number      500776

Duct Type      Flexible

Wet Rooms      4

**19.1 Mechanical extract ventilation - Decentralised**

SFP	Fan/Room Type	Count
0.14	In Room Fan Kitchen	1
0.11	In Room Fan Other Wet Room	3
0.00	In Duct Fan Kitchen Wet Room	0
0.00	In Duct Fan Other Wet Room	0
0.08	Through Wall Fan Kitchen	0
0.08	Through Wall Fan Other Wet Room	0

**20.0 Fans, Open Fireplaces, Flues**

**21.0 Fixed Cooling System**

No

**22.0 Lighting**

No Fixed Lighting      No

Name	Efficacy	Power	Capacity	Count
Lights	75.00	100	7500	15

**24.0 Main Heating 1**

Database

Percentage of Heat      100.00 %

Database Ref. No.      106393

Fuel Type      Electricity

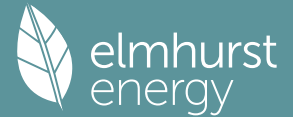
In Winter      388.25

In Summer      178.01

Model Name      Ecodan 8.5kW

Manufacturer      Mitsubishi Electric Europe B.V.

# Summary for Input Data



System Type	Heat Pump
Controls SAP Code	2207
Is MHS Pumped	Pump in unheated space
Heating Pump Age	2013 or later
Heat Emitter	Radiators and Underfloor
Underfloor Heating	Yes - Pipes in thin screed
Flow Temperature	Enter value
Flow Temperature Value	35.00

**25.0 Main Heating 2**

**26.0 Heat Networks**

**28.0 Water Heating**

Water Heating	Main Heating 1
SAP Code	901
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Cold Water Source	From mains
Bath Count	1
Immersion Only Heating Hot Water	No

**28.3 Waste Water Heat Recovery System**

**29.0 Hot Water Cylinder**

Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	No	
Cylinder In Heated Space	No	
Independent Time Control	No	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	1.58	kWh/day
Pipes insulation	Fully insulated primary pipework	
In Airing Cupboard	No	

**31.0 Thermal Store**

**32.0 Photovoltaic Unit**

One Dwelling	One Dwelling
Export Capable Meter?	No
Connected To Dwelling	Yes
Diverter	No
Battery Capacity [kWh]	0.00

PV Cells kWp	Orientation	Elevation	Overshading	FGHRS	MCS Certificate	Overshading Factor	MCS Certificate Reference	Panel Manufacturer
4.00	South	45°	None Or Little		No	1.00		

**34.0 Small-scale Hydro**

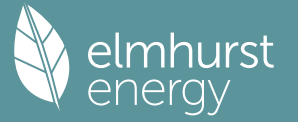
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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**Recommendations**

Lower cost measures  
None  
Further measures to achieve even higher standards

Typical Cost	Typical savings per year	Ratings after improvement	Environmental Impact
£4,000 - £6,000	£51	SAP rating B 90	A 98

# Summary for Input Data



£15,000 - £25,000

£630

0  
A 103

0  
A 100

# U-Value Calculation Report



## Assessor Details

Mr. Colin Thompson, E355-0002

## Roof Ceiling Tie - Earthwool Loft Roll 44

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/mK)	Resistance (m <sup>2</sup> K/W)	Fraction (%)	Density (kr/m <sup>3</sup> )	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	<b>Loft Space</b> Loft Space	0	0.0600	0.0600	100.00		
Layer 2	<b>Earthwool Loft Roll 44</b> Insulation	100	0.0440	2.2727	100.00		
Layer 3	<b>Earthwool Loft Roll 44</b> Insulation	100	0.0440	2.2727	100.00		
Layer 4	<b>Earthwool Loft Roll 44</b> Insulation Bridging - Timber	170	0.0440	3.8636	92.50		
		170	0.1300	1.3077	7.50		
Layer 5	<b>Plasterboard, standard</b> Standard	12.5	0.2100	0.0595	100.00		
Int surface				0.1000			

Total resistance: Upper limit = 8.405 m<sup>2</sup> K/W

Lower limit = 8.175 m<sup>2</sup> K/W

Average = 8.290 m<sup>2</sup> K/W

Total correction = 0.0024 m<sup>2</sup> K/W

U-value (unrounded) = 0.12 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 382 mm

U-value: 0.12 W/m<sup>2</sup> K

Kappa: n/a

# U-Value Calculation Report



## Assessor Details

Mr. Colin Thompson, E355-0002

## Wall 140 Kit Blockwork

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/mK)	Resistance (m <sup>2</sup> K/W)	Fraction (%)	Density (kr/m <sup>3</sup> )	Heat Cap. (J/kgK)
<b>Ext surface</b>				0.0400			
<b>Layer 1</b>	<b>Render - Cement and Sand</b>						
	Standard	19	1.0000	0.0190	100.00		
<b>Layer 2</b>	<b>Blockwork, dense</b>						
	Standard	100	1.5900	0.0629	100.00		
<b>Layer 3</b>	<b>Standard cavity</b>						
	Air Layer	50	0.0617	0.8100	100.00		
<b>Layer 4</b>	<b>Reflectashield TF</b>						
	Membrane	0.5	0.1000	0.0050	100.00		
<b>Layer 5</b>	<b>Plywood</b>						
	Standard	9.5	0.1300	0.0731	100.00		
<b>Layer 6</b>	<b>Earthwool Frametherm Roll 40</b>						
	Insulation	140	0.0400	3.5000	85.00		
	Bridging - Timber	140	0.1300	1.0769	15.00		
<b>Layer 7</b>	<b>Vapour Control Layer</b>						
	Membrane	0.1	0.0000	0.0000	100.00		
<b>Layer 8</b>	<b>Thermawall TW55 zero ODP</b>						
	Insulation	25	0.0220	1.1364	100.00		
<b>Layer 9</b>	<b>Standard cavity</b>						
	Air Layer	38	0.0487	0.7800	85.00		
	Bridging - Timber	38	0.1300	0.2923	15.00		
<b>Layer 10</b>	<b>Plasterboard, standard</b>						
	Standard	12.5	0.2100	0.0595	100.00		
<b>Int surface</b>				0.1300			

Total resistance: Upper limit = 6.006 m<sup>2</sup> K/W

Lower limit = 5.577 m<sup>2</sup> K/W

Average = 5.791 m<sup>2</sup> K/W

Total correction = 0.0024 m<sup>2</sup> K/W

U-value (unrounded) = 0.17 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 395 mm

U-value: 0.17 W/m<sup>2</sup> K

Kappa: n/a

# U-VALUE CALCULATOR REPORT

Property Reference	0224/06-Clubb	Issued on Date	06/03/2024
Assessment Reference		Prop Type Ref	
Project	Land at Lochhead Cottage, Rora, Peterhead		
Calculation Type	New Build (As Designed)		

SAP Rating		DER		TER	
Environmental		% DER<TER			
CO <sub>2</sub> Emissions (t/year)		DFEE		TFEE	
General Requirements Compliance		% DFEE<TFEE			

Assessor Details	Mr. Colin Thompson, CTA (Scotland) Ltd, Tel: 01467672451, admin@ctarchitect.co.uk	Assessor ID	E355-0002
Client			

## Building Elements

### Floor Ground Floor

Floor Type: Slab On Ground Floor  
 Area = 150.65 m<sup>2</sup>, Perimeter = 56.79 m, Wall thickness = 300.00 mm, Soil: Unknown  
 Horizontal edge insulation: none  
 Vertical edge insulation: none

Layer	Description	Thickness (mm)	Conductivity (W/m <sup>2</sup> K)	Resistance (m <sup>2</sup> K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	<b>Concrete, dense</b> Main construction	125	2.0000	0.0625	100.00
Layer 2	<b>Thermafloer TF70 zero ODP</b> Main construction Corrections - Air Gap: Level 1, Fasteners: None or plastic	110	0.0220	5.0000	100.00
Layer 3	<b>Screed</b> Main construction	65	1.1500	0.0565	100.00
Int surface				0.1700	

Total resistance:    **Upper limit** = 5.119 m<sup>2</sup> K/W            **Lower limit** = 5.119 m<sup>2</sup> K/W            **Average** = 5.119 m<sup>2</sup> K/W  
 Total correction = 0.0095 m<sup>2</sup> K/W                            **U-value (unrounded)** = 0.15 W/m<sup>2</sup> K

Unheated space:	None
<b>Total thickness: 300 mm</b>	<b>U-value: 0.15 W/m<sup>2</sup> K</b>
	<b>Kappa: n/a</b>