

21/03681/FUL

ENERGY EFFICIENCY STATEMENT

Required for discharge of condition 14

Proposed development to include erection of 3 no detached dwellings
and associated site works

at

42 West Drive, Highfields , Caldecote, CB23 7NY

for

Roxborough Plant and construction Ltd

The Proposal

The proposed small scale residential development consists of 3 no modestly sized detached homes. The development comprises 2 no House types, these are identical in every respect except that house type B has two ground floor bay windows on the gable end. In terms of the sanitary ware , kitchen ware and white goods provision the specification for each house will be exactly the same. To this end, the water efficiency specification will apply to both house types identically.

Planning Condition 14 States:

No development above ground level shall proceed until an Energy Statement has been submitted to and approved in writing by the local planning authority. The Statement shall demonstrate that a minimum of 10% carbon emissions (to be calculated by reference to a baseline for the anticipated carbon emissions for the property as defined by Building Regulations) can be reduced through the use of on-site renewable energy and low carbon technologies. The approved scheme shall be fully installed and operational prior to the occupation of the development and thereafter maintained in accordance with the approved details.

Reason: To ensure an energy efficient and sustainable development in accordance with Policy CC/3 of the adopted South Cambridgeshire Local Plan 2018 and the Greater Cambridge Sustainable Design and Construction SPD 2020.

Energy Efficiency Statement

As per the full SAP Calculations provided for each house on each site, the proposed dwellings are all passing the carbon emissions requirement by 10% or more. Each proposed property has 5Kw peak of PV (Photo Voltaic panels). Please refer to full SAP calculations provided in the following pages for exhaustive detail.

Full SAP Calculation Printout



Property Reference	RC-High Fields Cambridge-HTB		Issued on Date	17/05/2023	
Assessment Reference	001-HTB-Site 1	Prop Type Ref	DDC584-HTB-Site 1		
Property	42, West Drive, Cambridge, CB23 7NY				
SAP Rating	96 A	DER	9.17	TER	10.58
Environmental	91 B	% DER < TER			13.33
CO ₂ Emissions (t/year)	1.12	DLEE	39.26	TLEE	44.69
Compliance Check	See BREL	% DLEE < TLEE			12.15
% DPER < TPER	2.51	DPER	54.20	TPER	55.60
Assessor Details	Mr. Robert McFarland			Assessor ID	C974-0001
Client					

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	78.1700 (1b)	x 2.4000 (2b)	= 187.6080 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	148.0100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 357.3192 (5)

2. Ventilation rate

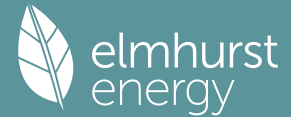
	Result	Reference
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 =	20.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	60.0000 / (5) =	0.1679 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3679 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3127 (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	0.3987	0.3909	0.3831	0.3440	0.3362	0.2971	0.2971	0.2893	0.3127	0.3362	0.3518	0.3675 (22b)
Effective ac	0.5795	0.5764	0.5734	0.5592	0.5565	0.5441	0.5441	0.5418	0.5489	0.5565	0.5619	0.5675 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			33.4200	0.7752	25.9070		(27)
Door			1.7500	1.0000	1.7500		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Rear Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			78.1700	0.1300	10.1621		(28a)
External Wall 1	165.8000	35.1700	130.6300	0.1600	20.9008		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)

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Loft	49.9200		49.9200	0.1100	5.4912	(30)
Rafter	36.9100	0.9400	35.9700	0.1100	3.9567	(30)
Total net area of external elements Aum(A, m2)			343.2000			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	70.7565	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges			Length	Psi-value	Total
K1 Element			24.2100	0.0560	1.3558
E2 Other lintels (including other steel lintels)			20.6400	0.0220	0.4541
E3 Sill			61.5900	0.0190	1.1702
E4 Jamb			27.9600	0.0570	1.5937
E10 Eaves (insulation at ceiling level)			10.2800	0.0600	0.6168
E11 Eaves (insulation at rafter level)			14.6200	0.1700	2.4854
E12 Gable (insulation at ceiling level)			15.8700	0.0860	1.3648
E13 Gable (insulation at rafter level)			44.2700	0.0450	1.9922
E16 Corner (normal)			20.2500	-0.0670	-1.3568
E17 Corner (inverted - internal area greater than external area)			1.2000	0.0610	0.0732
R1 Head of roof window			1.2000	0.0600	0.0720
R2 Sill of roof window			3.1200	0.0560	0.1747
R3 Jamb of roof window			6.3000	0.1200	0.7560
R5 Ridge (inverted)			17.2400	0.1200	2.0688
R6 Flat ceiling			17.8000	0.1200	2.1360
R8 Roof to wall (rafter)			40.8600	0.1960	8.0086
E5 Ground floor (normal)			35.4600	0.0020	0.0709
E6 Intermediate floor within a dwelling					

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.0364 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 93.7928 (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	68.3311	67.9671	67.6103	65.9346	65.6211	64.1615	64.1615	63.8912	64.7237	65.6211	66.2553	66.9184 (38)
Average = Sum(39)m / 12 =	162.1239	161.7600	161.4032	159.7274	159.4139	157.9544	157.9544	157.6841	158.5166	159.4139	160.0482	160.7113 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0954	1.0929	1.0905	1.0792	1.0770	1.0672	1.0672	1.0654	1.0710	1.0770	1.0813	1.0858 (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 2.9310 (42)												
Hot water usage for mixer showers 0.0000 (42a)												
Hot water usage for baths 88.7839 (42b)												
Hot water usage for other uses 46.9966 (42c)												
Average daily hot water use (litres/day) 125.3200 (43)												
Daily hot water use 135.7805 (44)												
Energy conte 212.5994 (45)												
Energy content (annual) Total = Sum(45)m = 2081.1199												
Distribution loss (46)m = 0.15 x (45)m 31.8899 (46)												
Water storage loss: 0.0000 (56)												
Total storage loss 0.0000 (57)												
If cylinder contains dedicated solar storage 0.0000 (59)												
Primary loss 43.5449 (61)												
Combi loss 256.1443 (62)												
Total heat required for water heating calculated for each month 181.1709 (63a)												
WWHRS -0.0000 (63b)												
PV diverter 0.0000 (63c)												
Solar input 0.0000 (63d)												
FGHRS 259.0723 (64)												
Output from w/h Total per year (kWh/year) = Sum(64)m = 2592.7712 (64)												
Electric shower(s) 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 81.5755 (65)												

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621 (66)
	74.9883	66.6039	54.1660	41.0071	30.6533	25.8788	27.9630	36.3473	48.7853	61.9442	72.2980	77.0725 (67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	475.1488	480.0793	467.6545	441.2035	407.8138	376.4322	355.4674	350.5368	362.9617	389.4127	422.8024	454.1840	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	(71)
Water heating gains (Table 5)	110.9522	108.3733	103.5564	93.2033	86.8155	80.1575	76.1590	79.6013	83.6194	91.0060	100.9413	109.6445	(72)
Total internal gains	778.2273	772.1946	742.5148	692.5519	642.4206	596.6065	573.7273	580.6235	609.5044	659.5008	713.1796	758.0389	(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	5.2400	10.6334	0.5700	0.7000	0.7700	15.4067 (74)
East	11.5200	19.6403	0.5700	0.7000	0.7700	62.5613 (76)
South	7.2800	46.7521	0.5700	0.7000	0.7700	94.1105 (78)
West	9.3800	19.6403	0.5700	0.7000	0.7700	50.9397 (80)
East	0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)
West	0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)

Solar gains	231.9996	423.7616	643.3931	883.6287	1054.0505	1070.8240	1022.5231	894.2264	727.7625	486.6818	283.3857	194.8203	(83)
Total gains	1010.2269	1195.9562	1385.9079	1576.1805	1696.4711	1667.4305	1596.2504	1474.8498	1337.2669	1146.1826	996.5654	952.8592	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	114.1179	114.3747	114.6275	115.8301	116.0579	117.1303	117.1303	117.3311	116.7149	116.0579	115.5980	115.1211	
alpha	8.6079	8.6250	8.6418	8.7220	8.7372	8.8087	8.8087	8.8221	8.7810	8.7372	8.7065	8.6747	
util living area	0.9999	0.9993	0.9956	0.9639	0.8275	0.6033	0.4352	0.4913	0.7883	0.9874	0.9995	0.9999	(86)
MIT	20.2423	20.3708	20.5710	20.8151	20.9648	20.9978	20.9999	20.9997	20.9823	20.7646	20.4507	20.2192	(87)
Th 2	20.0046	20.0066	20.0086	20.0179	20.0196	20.0277	20.0277	20.0292	20.0246	20.0196	20.0161	20.0124	(88)
util rest of house	0.9998	0.9989	0.9926	0.9421	0.7599	0.5135	0.3392	0.3880	0.6926	0.9759	0.9991	0.9999	(89)
MIT 2	19.1248	19.2910	19.5475	19.8510	19.9984	20.0270	20.0277	20.0292	20.0172	19.7998	19.4014	19.1016	(90)
Living area fraction													fLA = Living area / (4) =
MIT	19.6186	19.7681	19.9997	20.2770	20.4254	20.4560	20.4573	20.4580	20.4436	20.2261	19.8650	19.5954	(92)
Temperature adjustment													-0.1500
adjusted MIT	19.4686	19.6181	19.8497	20.1270	20.2754	20.3060	20.3073	20.3080	20.2936	20.0761	19.7150	19.4454	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9997	0.9987	0.9920	0.9450	0.7788	0.5394	0.3668	0.4177	0.7206	0.9768	0.9989	0.9998	(94)
Useful gains	1009.9458	1194.3848	1374.8378	1489.5509	1321.1842	899.4463	585.5261	616.0677	963.5956	1119.5939	995.4845	952.6981	(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	2459.1873	2380.8045	2154.6872	1793.2560	1367.0335	901.2854	585.5802	616.2303	981.7874	1510.6225	2019.0117	2450.1123	(97)
Space heating kWh	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762	(98a)
Space heating requirement - total per year (kWh/year)													4850.4384
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	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													4850.4384
Space heating per m2													(98c) / (4) =
													32.7710 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.1000 (201)
Fraction of space heat from main system(s)													0.9000 (202)
Efficiency of main space heating system 1 (in %)													84.0000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)

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Space heating fuel (main heating system)	1155.2526	854.2222	621.6514	234.2868	36.5484	0.0000	0.0000	0.0000	0.0000	311.7057	789.5781	1193.6531	(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)	165.8824	122.6576	89.2628	33.6412	5.2480	0.0000	0.0000	0.0000	0.0000	44.7577	113.3753	171.3963	(215)
Water heating requirement	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(64)
Efficiency of water heater	88.6363	88.5830	88.4537	88.1097	87.5177	87.3000	87.3000	87.3000	87.3000	88.2265	88.5574	88.6487	(216)
Fuel for water heating, kWh/month	292.2869	258.2724	274.1694	240.9014	234.2733	210.7565	207.5268	216.3553	219.3489	243.0256	258.6164	288.9430	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	65.6368	52.6563	47.4112	34.7354	26.8307	21.9209	24.4758	31.8146	41.3240	54.2194	61.2406	67.4611	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-73.1711	-99.8626	-138.6981	-149.8936	-156.0878	-143.5215	-141.9570	-137.1464	-127.0881	-111.9399	-79.3781	-63.6543	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-52.0452	-109.0873	-217.1675	-327.0365	-433.1192	-435.7628	-429.6718	-362.2885	-264.0697	-155.1748	-69.1464	-41.1303	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												5196.8983	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												746.2213	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2944.4759	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												529.7268	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4318.0985	(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												5185.2238	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5196.8983	3.6400	189.1671	(240)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	746.2213	5.1200	38.2065	(242)
Water heating (other fuel)	2944.4759	3.6400	107.1789	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	529.7268	16.4900	87.3519	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1422.3985	16.4900	-234.5535	
PV Unit electricity exported	-2895.7000	5.5900	-161.8696	
Total			-396.4231	(252)
Total energy cost			131.6628	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2456	(257)
SAP value		96.0192	
SAP rating (Section 12)		96	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5196.8983	0.2100	1091.3486 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	746.2213	0.0280	20.8942 (263)
Water heating (other fuel)	2944.4759	0.2100	618.3399 (264)
Space and water heating			1730.5828 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	529.7268	0.1443	76.4559 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1422.3985	0.1354	-192.5946
PV Unit electricity exported	-2895.7000	0.1259	-364.5044
Total			-557.0990 (269)
Total CO2, kg/year			1261.8690 (272)
CO2 emissions per m2			8.5300 (273)
EI value			91.2393
EI rating			91 (274)
EI band			B

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	78.1700 (1b)	x 2.4000 (2b)	= 187.6080 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	148.0100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	357.3192 (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	1 * 20 = 20.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	60.0000 / (5) = 0.1679 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3679 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3127 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3675	0.3518	0.3518	0.3205	0.3127	0.2736	0.2815	0.2893	0.2971	0.3049	0.3127	0.3284 (22b)
Effective ac	0.5675	0.5619	0.5619	0.5514	0.5489	0.5374	0.5396	0.5418	0.5441	0.5465	0.5489	0.5539 (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
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Windows (Uw = 0.80)			33.4200	0.7752	25.9070	(27)
Door			1.7500	1.0000	1.7500	(26)
Front Rooflight			0.4700	0.7752	0.3643	(27a)
Rear Rooflight			0.4700	0.7752	0.3643	(27a)
Heatloss Floor 1			78.1700	0.1300	10.1621	(28a)
External Wall 1	165.8000	35.1700	130.6300	0.1600	20.9008	(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600	(29a)
Loft	49.9200		49.9200	0.1100	5.4912	(30)
Rafter	36.9100	0.9400	35.9700	0.1100	3.9567	(30)
Total net area of external elements Aum(A, m2)			343.2000			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	70.7565	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	24.2100	0.0560	1.3558
E3 Sill	20.6400	0.0220	0.4541
E4 Jamb	61.5900	0.0190	1.1702
E10 Eaves (insulation at ceiling level)	27.9600	0.0570	1.5937
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	44.2700	0.0450	1.9922
E17 Corner (inverted - internal area greater than external area)	20.2500	-0.0670	-1.3568
R1 Head of roof window	1.2000	0.0610	0.0732
R2 Sill of roof window	1.2000	0.0600	0.0720
R3 Jamb of roof window	3.1200	0.0560	0.1747
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	40.8600	0.1960	8.0086
E6 Intermediate floor within a dwelling	35.4600	0.0020	0.0709

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.0364 (36)
 Point Thermal bridges 0.0000 (36a) =
 Total fabric heat loss (33) + (36) + (36a) = 93.7928 (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	66.9184	66.2553	66.2553	65.0156	64.7237	63.3723	63.6282	63.8912	64.1615	64.4390	64.7237	65.3147 (38)
Average = Sum(39)m / 12 =	160.7113	160.0482	160.0482	158.8085	158.5166	157.1651	157.4210	157.6841	157.9544	158.2319	158.5166	159.1076 (39)
												158.6844

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0858	1.0813	1.0813	1.0730	1.0710	1.0619	1.0636	1.0654	1.0672	1.0691	1.0710	1.0750 (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													2.9310 (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	89.0851	87.7620	85.8989	82.4637	79.8914	77.0391	75.4985	77.3486	79.3630	82.4150	85.9210	88.7839	(42b)
Hot water usage for other uses	46.9966	45.2876	43.5786	41.8697	40.1607	38.4517	38.4517	40.1607	41.8697	43.5786	45.2876	46.9966	(42c)
Average daily hot water use (litres/day)													125.3200 (43)
Daily hot water use	136.0816	133.0496	129.4775	124.3333	120.0521	115.4909	113.9502	117.5093	121.2326	125.9936	131.2086	135.7805	(44)
Energy content (annual)	215.5200	189.4609	199.0021	170.2061	161.6132	142.0095	137.8129	145.5010	149.4920	170.9721	186.9307	212.5994	(45)
Distribution loss (46)m = 0.15 x (45)m	32.3280	28.4191	29.8503	25.5309	24.2420	21.3014	20.6719	21.8252	22.4238	25.6458	28.0396	31.8899	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	43.5522	39.3245	43.5109	42.0514	43.4175	41.9809	43.3580	43.3772	41.9996	43.4409	42.0932	43.5449	(61)
Total heat required for water heating calculated for each month	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(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	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(64)
													Total per year (kWh/year) = Sum(64)m = 2592.7712 (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	82.5485	72.8269	77.0459	67.1064	64.5907	57.7134	56.6623	59.2234	60.2060	67.7085	72.6778	81.5755	(65)

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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	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.9883	66.6039	54.1660	41.0071	30.6533	25.8788	27.9630	36.3473	48.7853	61.9442	72.2980	77.0725 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	475.1488	480.0793	467.6545	441.2035	407.8138	376.4322	355.4674	350.5368	362.9617	389.4127	422.8024	454.1840 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414 (71)
Water heating gains (Table 5)	110.9522	108.3733	103.5564	93.2033	86.8155	80.1575	76.1590	79.6013	83.6194	91.0060	100.9413	109.6445 (72)
Total internal gains	778.2273	772.1946	742.5148	692.5519	642.4206	596.6065	573.7273	580.6235	609.5044	659.5008	713.1796	758.0389 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
North	5.2400	12.0687	0.5700	0.7000	0.7000	0.7700	17.4863 (74)					
East	11.5200	22.4348	0.5700	0.7000	0.7000	0.7700	71.4628 (76)					
South	7.2800	51.9047	0.5700	0.7000	0.7000	0.7700	104.4826 (78)					
West	9.3800	22.4348	0.5700	0.7000	0.7000	0.7700	58.1876 (80)					
East	0.4700	30.5536	0.5700	0.7000	0.7000	1.0000	5.1567 (82)					
West	0.4700	30.5536	0.5700	0.7000	0.7000	1.0000	5.1567 (82)					
Solar gains	261.9328	446.0862	659.2126	931.5047	1083.6384	1148.9268	1084.9785	952.8547	779.5304	535.4352	319.4254	217.7940 (83)
Total gains	1040.1601	1218.2808	1401.7274	1624.0566	1726.0590	1745.5333	1658.7059	1533.4782	1389.0348	1194.9360	1032.6051	975.8329 (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	115.1211	115.5980	115.5980	116.5004	116.7149	117.7185	117.5272	117.3311	117.1303	116.9249	116.7149	116.2814
alpha	8.6747	8.7065	8.7065	8.7667	8.7810	8.8479	8.8351	8.8221	8.8087	8.7950	8.7810	8.7521
util living area	0.9998	0.9991	0.9939	0.9446	0.7738	0.5036	0.3322	0.3599	0.6746	0.9732	0.9992	0.9999 (86)
MIT	20.2798	20.4065	20.6140	20.8621	20.9805	20.9995	21.0000	21.0000	20.9952	20.8335	20.4969	20.2549 (87)
Th 2	20.0124	20.0161	20.0161	20.0230	20.0246	20.0321	20.0307	20.0292	20.0277	20.0262	20.0246	20.0213 (88)
util rest of house	0.9997	0.9986	0.9899	0.9138	0.6989	0.4170	0.2402	0.2601	0.5699	0.9502	0.9985	0.9998 (89)
MIT 2	19.1792	19.3445	19.6079	19.9065	20.0142	20.0320	20.0307	20.0292	20.0263	19.8852	19.4674	19.1545 (90)
Living area fraction									fLA = Living area / (4) =			0.4419 (91)
MIT	19.6655	19.8137	20.0524	20.3287	20.4412	20.4595	20.4590	20.4582	20.4544	20.3042	19.9223	19.6407 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5155	19.6637	19.9024	20.1787	20.2912	20.3095	20.3090	20.3082	20.3044	20.1542	19.7723	19.4907 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9996	0.9983	0.9893	0.9196	0.7203	0.4419	0.2666	0.2888	0.6004	0.9540	0.9983	0.9998 (94)
Useful gains	1039.7603	1216.2292	1386.7381	1493.4322	1243.3244	771.2912	442.1902	442.7971	833.9599	1140.0019	1030.8522	975.6138 (95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000 (96)
Heat loss rate W	2413.1560	2330.8972	2081.0133	1711.7532	1266.7366	771.6055	442.1930	442.8026	837.8587	1401.0182	1961.2109	2401.0477 (97)
Space heating kWh	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228 (98a)
Space heating requirement - total per year (kWh/year)												4386.5910
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	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4386.5910
Space heating per m ²										(98c) / (4) =		29.6371 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	84.0000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	1094.7926	802.5609	553.4365	168.4191	18.6629	0.0000	0.0000	0.0000	0.0000	208.0673	717.7053	1136.2744	(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)	157.2010	115.2395	79.4678	24.1833	2.6798	0.0000	0.0000	0.0000	0.0000	29.8763	103.0551	163.1574	(215)
Water heating													
Water heating requirement	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(64)
Efficiency of water heater (217)m	88.6207	88.5630	88.4098	87.9721	87.4186	87.3000	87.3000	87.3000	87.3000	88.0553	88.5254	87.3000	(216)
Fuel for water heating, kWh/month	292.3383	258.3306	274.3057	241.2783	234.5389	210.7565	207.5268	216.3553	219.3489	243.4980	258.7098	288.9884	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	65.6368	52.6563	47.4112	34.7354	26.8307	21.9209	24.4758	31.8146	41.3240	54.2194	61.2406	67.4611	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.9306	-103.1912	-140.5351	-153.1274	-157.4642	-146.3133	-144.3089	-140.0537	-130.8182	-118.0135	-86.1137	-69.2111	(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	-61.7164	-117.1523	-224.5332	-349.9154	-448.3224	-475.1614	-462.2158	-392.2951	-288.5673	-176.3275	-81.6184	-48.1610	(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													4699.9190 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													674.8602 (215)
Efficiency of water heater													87.3000
Water heating fuel used													2945.9756 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													86.0000 (231)
Electricity for lighting (calculated in Appendix L)													529.7268 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4595.0671 (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													4341.4144 (238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4699.9190	3.5000	164.4972	(240)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	674.8602	6.3000	42.5162	(242)
Water heating (other fuel)	2945.9756	3.5000	103.1091	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154	(249)
Energy for lighting	529.7268	18.3900	97.4168	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1469.0809	18.3900	-270.1640	
PV Unit electricity exported	-3125.9861	5.8100	-181.6198	
Total			-451.7838	(252)
Total energy cost			65.5709	(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	4699.9190	0.2100	986.9830 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	674.8602	0.0280	18.8961 (263)
Water heating (other fuel)	2945.9756	0.2100	618.6549 (264)
Space and water heating			1624.5339 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	529.7268	0.1443	76.4559 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1469.0809	0.1356	-199.2798
PV Unit electricity exported	-3125.9861	0.1260	-393.7505
Total			-593.0303 (269)
Total CO2, kg/year			1119.8888 (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	4699.9190	1.1300	5310.9084 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	674.8602	1.0460	705.9037 (277)
Water heating (other fuel)	2945.9756	1.1300	3328.9524 (278)
Space and water heating			9345.7646 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	529.7268	1.5338	812.5126 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1469.0809	1.5014	-2205.6622
PV Unit electricity exported	-3125.9861	0.4623	-1445.2402
Total			-3650.9024 (283)
Total Primary energy kWh/year			6637.4756 (286)

SAP 10 EPC IMPROVEMENTS

001-HTB-Site 1

Current energy efficiency rating: A 96
 Current environmental impact rating: B 91

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

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Measures omitted - SAP change or cost saving too small:
 N Solar water heating + 0.4 -£ 15 -153 kg (13.6%)

Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings	£0	0.00 kg/m ²

Potential energy efficiency rating: A 96
 Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£113	£113	£0
Mains gas	£362	£362	£0
Wood	£43	£43	£0
Space heating	£317	£317	£0
Water heating	£103	£103	£0
Lighting	£97	£97	£0
Generated (PV)	-£452	-£452	£0
Total cost of fuels	£66	£66	£0
Total cost of uses	£65	£65	£0
Delivered energy	29 kWh/m ²	29 kWh/m ²	0 kWh/m ²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m ²	8 kg/m ²	8 kg/m ²	0 kg/m ²
Primary energy	45 kWh/m ²	45 kWh/m ²	0 kWh/m ²

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	78.1700 (1b)	x 2.4000 (2b)	= 187.6080 (1b)
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	148.0100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 357.3192 (5)

2. Ventilation rate

		m ³ per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 =	20.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	60.0000 / (5) =	0.1679 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3679 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3127 (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	0.3987	0.3909	0.3831	0.3440	0.3362	0.2971	0.2971	0.2893	0.3127	0.3362	0.3518	0.3675 (22b)
Effective ac	0.5795	0.5764	0.5734	0.5592	0.5565	0.5441	0.5441	0.5418	0.5489	0.5565	0.5619	0.5675 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			33.4200	0.7752	25.9070		(27)
Door			1.7500	1.0000	1.7500		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Rear Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			78.1700	0.1300	10.1621		(28a)
External Wall 1	165.8000	35.1700	130.6300	0.1600	20.9008		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	49.9200		49.9200	0.1100	5.4912		(30)
Rafter	36.9100	0.9400	35.9700	0.1100	3.9567		(30)
Total net area of external elements Aum(A, m ²)			343.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	70.7565	(33)

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

450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	24.2100	0.0560	1.3558
E3 Sill	20.6400	0.0220	0.4541
E4 Jamb	61.5900	0.0190	1.1702
E10 Eaves (insulation at ceiling level)	27.9600	0.0570	1.5937
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	44.2700	0.0450	1.9922
E17 Corner (inverted - internal area greater than external area)	20.2500	-0.0670	-1.3568
R1 Head of roof window	1.2000	0.0610	0.0732

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R2 Sill of roof window	1.2000	0.0600	0.0720
R3 Jamb of roof window	3.1200	0.0560	0.1747
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	40.8600	0.1960	8.0086
E6 Intermediate floor within a dwelling	35.4600	0.0020	0.0709
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			23.0364 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss		(33) + (36) + (36a) =	93.7928 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	68.3311	67.9671	67.6103	65.9346	65.6211	64.1615	64.1615	63.8912	64.7237	65.6211	66.2553	66.9184 (38)
Heat transfer coeff	162.1239	161.7600	161.4032	159.7274	159.4139	157.9544	157.9544	157.6841	158.5166	159.4139	160.0482	160.7113 (39)
Average = Sum(39)m / 12 =												159.7259

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0954	1.0929	1.0905	1.0792	1.0770	1.0672	1.0672	1.0654	1.0710	1.0770	1.0813	1.0858 (40)
HLP (average)												1.0792
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9310 (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	89.0851	87.7620	85.8989	82.4637	79.8914	77.0391	75.4985	77.3486	79.3630	82.4150	85.9210	88.7839 (42b)
Hot water usage for other uses	46.9966	45.2876	43.5786	41.8697	40.1607	38.4517	38.4517	40.1607	41.8697	43.5786	45.2876	46.9966 (42c)
Average daily hot water use (litres/day)												125.3200 (43)
Daily hot water use	136.0816	133.0496	129.4775	124.3333	120.0521	115.4909	113.9502	117.5093	121.2326	125.9936	131.2086	135.7805 (44)
Energy conte	215.5200	189.4609	199.0021	170.2061	161.6132	142.0095	137.8129	145.5010	149.4920	170.9721	186.9307	212.5994 (45)
Energy content (annual)										Total = Sum(45)m =		2081.1199
Distribution loss (46)m = 0.15 x (45)m	32.3280	28.4191	29.8503	25.5309	24.2420	21.3014	20.6719	21.8252	22.4238	25.6458	28.0396	31.8899 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	43.5522	39.3245	43.5109	42.0514	43.4175	41.9809	43.3580	43.3772	41.9996	43.4409	42.0932	43.5449 (61)
Total heat required for water heating calculated for each month	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443 (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	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443 (64)
									Total per year (kWh/year) = Sum(64)m =			2592.7712 (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	82.5485	72.8269	77.0459	67.1064	64.5907	57.7134	56.6623	59.2234	60.2060	67.7085	72.6778	81.5755 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.9883	66.0039	54.1660	41.0071	30.6533	25.8788	27.9630	36.3473	48.7853	61.9442	72.2980	77.0725 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	475.1488	480.0793	467.6545	441.2035	407.8138	376.4322	355.4674	350.5368	362.9617	389.4127	422.8024	454.1840 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414 (71)
Water heating gains (Table 5)	110.9522	108.3733	103.5564	93.2033	86.8155	80.1575	76.1590	79.6013	83.6194	91.0060	100.9413	109.6445 (72)
Total internal gains	778.2273	772.1946	742.5148	692.5519	642.4206	596.6065	573.7273	580.6235	609.5044	659.5008	713.1796	758.0389 (73)

6. Solar gains

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[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		5.2400	10.6334	0.5700	0.7000	0.7700	15.4067 (74)
East		11.5200	19.6403	0.5700	0.7000	0.7700	62.5613 (76)
South		7.2800	46.7521	0.5700	0.7000	0.7700	94.1105 (78)
West		9.3800	19.6403	0.5700	0.7000	0.7700	50.9397 (80)
East		0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)
West		0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)

Solar gains	231.9996	423.7616	643.3931	883.6287	1054.0505	1070.8240	1022.5231	894.2264	727.7625	486.6818	283.3857	194.8203 (83)
Total gains	1010.2269	1195.9562	1385.9079	1576.1805	1696.4711	1667.4305	1596.2504	1474.8498	1337.2669	1146.1826	996.5654	952.8592 (84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	114.1179	114.3747	114.6275	115.8301	116.0579	117.1303	117.1303	117.3311	116.7149	116.0579	115.5980	115.1211
alpha	8.6079	8.6250	8.6418	8.7220	8.7372	8.8087	8.8087	8.8221	8.7810	8.7372	8.7065	8.6747
util living area	0.9999	0.9993	0.9956	0.9639	0.8275	0.6033	0.4352	0.4913	0.7883	0.9874	0.9995	0.9999 (86)
MIT	20.2423	20.3708	20.5710	20.8151	20.9648	20.9978	20.9999	20.9997	20.9823	20.7646	20.4507	20.2192 (87)
Th 2	20.0046	20.0066	20.0086	20.0179	20.0196	20.0277	20.0277	20.0292	20.0246	20.0196	20.0161	20.0124 (88)
util rest of house	0.9998	0.9989	0.9926	0.9421	0.7599	0.5135	0.3392	0.3880	0.6926	0.9759	0.9991	0.9999 (89)
MIT 2	19.1248	19.2910	19.5475	19.8510	19.9984	20.0270	20.0277	20.0292	20.0172	19.7998	19.4014	19.1016 (90)
Living area fraction	19.6186	19.7681	19.9997	20.2770	20.4254	20.4560	20.4573	20.4580	20.4436	20.2261	19.8650	19.5954 (91)
MIT												19.5954 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.4686	19.6181	19.8497	20.1270	20.2754	20.3060	20.3073	20.3080	20.2936	20.0761	19.7150	19.4454 (93)

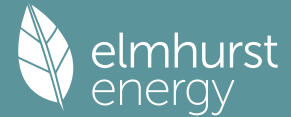
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9997	0.9987	0.9920	0.9450	0.7788	0.5394	0.3668	0.4177	0.7206	0.9768	0.9989	0.9998 (94)
Useful gains	1009.9458	1194.3848	1374.8378	1489.5509	1321.1842	899.4463	585.5261	616.0677	963.5956	1119.5939	995.4845	952.6981 (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	2459.1873	2380.8045	2154.6872	1793.2560	1367.0335	901.2854	585.5802	616.2303	981.7874	1510.6225	2019.0117	2450.1123 (97)
Space heating kWh	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762 (98a)
Space heating requirement - total per year (kWh/year)												4850.4384
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	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4850.4384
Space heating per m2												(98c) / (4) = 32.7710 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												84.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement	1078.2357	797.2741	580.2080	218.6676	34.1119	0.0000	0.0000	0.0000	0.0000	290.9253	736.9396	1114.0762 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1155.2526	854.2222	621.6514	234.2868	36.5484	0.0000	0.0000	0.0000	0.0000	311.7057	789.5781	1193.6531 (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)	165.8824	122.6576	89.2628	33.6412	5.2480	0.0000	0.0000	0.0000	0.0000	44.7577	113.3753	171.3963 (215)
Water heating												
Water heating requirement	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443 (64)
Efficiency of water heater	88.6363	88.5830	88.4537	88.1097	87.5177	87.3000	87.3000	87.3000	87.3000	88.2265	88.5574	87.3000 (216)
Fuel for water heating, kWh/month	292.2869	258.2724	274.1694	240.9014	234.2733	210.7565	207.5268	216.3553	219.3489	243.0256	258.6164	288.9430 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)

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Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	65.6368	52.6563	47.4112	34.7354	26.8307	21.9209	24.4758	31.8146	41.3240	54.2194	61.2406	67.4611	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.1711	-99.8626	-138.6981	-149.8936	-156.0878	-143.5215	-141.9570	-137.1464	-127.0881	-111.9399	-79.3781	-63.6543	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-52.0452	-109.0873	-217.1675	-327.0365	-433.1192	-435.7628	-429.6718	-362.2885	-264.0697	-155.1748	-69.1464	-41.1303	(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												5196.8983	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												746.2213	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2944.4759	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												529.7268	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4318.0985	(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												5185.2238	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5196.8983	3.6400	189.1671	(240)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	746.2213	5.1200	38.2065	(242)
Water heating (other fuel)	2944.4759	3.6400	107.1789	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	529.7268	16.4900	87.3519	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1422.3985	16.4900	-234.5535	
PV Unit electricity exported	-2895.7000	5.5900	-161.8696	
Total			-396.4231	(252)
Total energy cost			131.6628	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2456	(257)
SAP value		96.0192	
SAP rating (Section 12)		96	(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	5196.8983	0.2100	1091.3486	(261)
Total CO2 associated with community systems			0.0000	(373)
Space heating - secondary	746.2213	0.0280	20.8942	(263)
Water heating (other fuel)	2944.4759	0.2100	618.3399	(264)
Space and water heating			1730.5828	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	529.7268	0.1443	76.4559	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1422.3985	0.1354	-192.5946	
PV Unit electricity exported	-2895.7000	0.1259	-364.5044	

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Total	-557.0990 (269)
Total CO2, kg/year	1261.8690 (272)
CO2 emissions per m2	8.5300 (273)
EI value	91.2393
EI rating	91 (274)
EI band	B

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	78.1700 (1b)	x 2.4000 (2b)	= 187.6080 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	148.0100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 357.3192 (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	1 * 20 = 20.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	60.0000 / (5) = 0.1679 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3679 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3127 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3675	0.3518	0.3518	0.3205	0.3127	0.2736	0.2815	0.2893	0.2971	0.3049	0.3127	0.3284 (22b)
Effective ac	0.5675	0.5619	0.5619	0.5514	0.5489	0.5374	0.5396	0.5418	0.5441	0.5465	0.5489	0.5539 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 0.80)			33.4200	0.7752	25.9070		(27)
Door			1.7500	1.0000	1.7500		(26)
Front Roofflight			0.4700	0.7752	0.3643		(27a)
Rear Roofflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			78.1700	0.1300	10.1621		(28a)
External Wall 1	165.8000	35.1700	130.6300	0.1600	20.9008		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	49.9200		49.9200	0.1100	5.4912		(30)
Rafter	36.9100	0.9400	35.9700	0.1100	3.9567		(30)
Total net area of external elements Aum(A, m2)			343.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 70.7565		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total
E2 Other lintels (including other steel lintels)				24.2100	0.0560		1.3558
E3 Sill				20.6400	0.0220		0.4541
E4 Jamb				61.5900	0.0190		1.1702

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E10 Eaves (insulation at ceiling level)	27.9600	0.0570	1.5937
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	44.2700	0.0450	1.9922
E17 Corner (inverted - internal area greater than external area)	20.2500	-0.0670	-1.3568
R1 Head of roof window	1.2000	0.0610	0.0732
R2 Sill of roof window	1.2000	0.0600	0.0720
R3 Jamb of roof window	3.1200	0.0560	0.1747
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	40.8600	0.1960	8.0086
E6 Intermediate floor within a dwelling	35.4600	0.0020	0.0709
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			23.0364 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	93.7928 (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)
Heat transfer coeff	66.9184	66.2553	66.2553	65.0156	64.7237	63.3723	63.6282	63.8912	64.1615	64.4390	64.7237	65.3147	
Average = Sum(39)m / 12 =	160.7113	160.0482	160.0482	158.8085	158.5166	157.1651	157.4210	157.6841	157.9544	158.2319	158.5166	159.1076	(39)
													158.6844
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0858	1.0813	1.0813	1.0730	1.0710	1.0619	1.0636	1.0654	1.0672	1.0691	1.0710	1.0750	(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													2.9310 (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	89.0851	87.7620	85.8989	82.4637	79.8914	77.0391	75.4985	77.3486	79.3630	82.4150	85.9210	88.7839	(42b)
Hot water usage for other uses	46.9966	45.2876	43.5786	41.8697	40.1607	38.4517	38.4517	40.1607	41.8697	43.5786	45.2876	46.9966	(42c)
Average daily hot water use (litres/day)													125.3200 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	136.0816	133.0496	129.4775	124.3333	120.0521	115.4909	113.9502	117.5093	121.2326	125.9936	131.2086	135.7805	(44)
Energy content (annual)	215.5200	189.4609	199.0021	170.2061	161.6132	142.0095	137.8129	145.5010	149.4920	170.9721	186.9307	212.5994	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2081.1199
Water storage loss:	32.3280	28.4191	29.8503	25.5309	24.2420	21.3014	20.6719	21.8252	22.4238	25.6458	28.0396	31.8899	(46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	43.5522	39.3245	43.5109	42.0514	43.4175	41.9809	43.3580	43.3772	41.9996	43.4409	42.0932	43.5449	(61)
Total heat required for water heating calculated for each month	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(62)
MWHR	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)
FGHR	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	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443	(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	82.5485	72.8269	77.0459	67.1064	64.5907	57.7134	56.6623	59.2234	60.2060	67.7085	72.6778	81.5755	(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	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	175.8621	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.9883	66.6039	54.1660	41.0071	30.6533	25.8788	27.9630	36.3473	48.7853	61.9442	72.2980	77.0725	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	475.1488	480.0793	467.6545	441.2035	407.8138	376.4322	355.4674	350.5368	362.9617	389.4127	422.8024	454.1840	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	55.5172	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	-117.2414	(71)
Water heating gains (Table 5)	110.9522	108.3733	103.5564	93.2033	86.8155	80.1575	76.1590	79.6013	83.6194	91.0060	100.9413	109.6445	(72)
Total internal gains	778.2273	772.1946	742.5148	692.5519	642.4206	596.6065	573.7273	580.6235	609.5044	659.5008	713.1796	758.0389	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.2400	12.0687	0.5700	0.7000	0.7700	17.4863 (74)	
East	11.5200	22.4348	0.5700	0.7000	0.7700	71.4628 (76)	
South	7.2800	51.9047	0.5700	0.7000	0.7700	104.4826 (78)	
West	9.3800	22.4348	0.5700	0.7000	0.7700	58.1876 (80)	
East	0.4700	30.5536	0.5700	0.7000	1.0000	5.1567 (82)	
West	0.4700	30.5536	0.5700	0.7000	1.0000	5.1567 (82)	

Solar gains	261.9328	446.0862	659.2126	931.5047	1083.6384	1148.9268	1084.9785	952.8547	779.5304	535.4352	319.4254	217.7940 (83)
Total gains	1040.1601	1218.2808	1401.7274	1624.0566	1726.0590	1745.5333	1658.7059	1533.4782	1389.0348	1194.9360	1032.6051	975.8329 (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	115.1211	115.5980	115.5980	116.5004	116.7149	117.7185	117.5272	117.3311	117.1303	116.9249	116.7149	116.2814
alpha	8.6747	8.7065	8.7065	8.7667	8.7810	8.8479	8.8351	8.8221	8.8087	8.7950	8.7810	8.7521
util living area	0.9998	0.9991	0.9939	0.9446	0.7738	0.5036	0.3322	0.3599	0.6746	0.9732	0.9992	0.9999 (86)
MIT	20.2798	20.4065	20.6140	20.8621	20.9805	20.9995	21.0000	21.0000	20.9952	20.8335	20.4969	20.2549 (87)
Th 2	20.0124	20.0161	20.0161	20.0230	20.0246	20.0321	20.0307	20.0292	20.0277	20.0262	20.0246	20.0213 (88)
util rest of house	0.9997	0.9986	0.9899	0.9138	0.6989	0.4170	0.2402	0.2601	0.5699	0.9502	0.9985	0.9998 (89)
MIT 2	19.1792	19.3445	19.6079	19.9065	20.0142	20.0320	20.0307	20.0292	20.0263	19.8852	19.4674	19.1545 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.6655	19.8137	20.0524	20.3287	20.4412	20.4595	20.4590	20.4582	20.4544	20.3042	19.9223	0.4419 (91)
Temperature adjustment	-0.1500											
adjusted MIT	19.5155	19.6637	19.9024	20.1787	20.2912	20.3095	20.3090	20.3082	20.3044	20.1542	19.7723	19.4907 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9996	0.9983	0.9893	0.9196	0.7203	0.4419	0.2666	0.2888	0.6004	0.9540	0.9983	0.9998 (94)
Useful gains	1039.7603	1216.2292	1386.7381	1493.4322	1243.3244	771.2912	442.1902	442.7971	833.9599	1140.0019	1030.8522	975.6138 (95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000 (96)
Heat loss rate W	2413.1560	2330.8972	2081.0133	1711.7532	1266.7366	771.6055	442.1930	442.8026	837.8587	1401.0182	1961.2109	2401.0477 (97)
Space heating kWh	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228 (98a)
Space heating requirement - total per year (kWh/year)	4386.5910											
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	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4386.5910											
Space heating per m2	(98c) / (4) = 29.6371 (99)											

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)											
Fraction of space heat from main system(s)	0.9000 (202)											
Efficiency of main space heating system 1 (in %)	84.0000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	65.0000 (208)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1021.8064	749.0569	516.5407	157.1912	17.4187	0.0000	0.0000	0.0000	0.0000	194.1961	669.8583	1060.5228 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1094.7926	802.5609	553.4365	168.4191	18.6629	0.0000	0.0000	0.0000	0.0000	208.0673	717.7053	1136.2744 (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)	157.2010	115.2395	79.4678	24.1833	2.6798	0.0000	0.0000	0.0000	0.0000	29.8763	103.0551	163.1574 (215)

Water heating
Water heating requirement

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Efficiency of water heater (217)m	259.0723	228.7854	242.5131	212.2575	205.0306	183.9904	181.1709	188.8782	191.4916	214.4130	229.0239	256.1443 (64)
Fuel for water heating, kWh/month	88.6207	88.5630	88.4098	87.9721	87.4186	87.3000	87.3000	87.3000	87.3000	88.0553	88.5254	87.3000 (216)
Space cooling fuel requirement (221)m	292.3383	258.3306	274.3057	241.2783	234.5389	210.7565	207.5268	216.3553	219.3489	243.4980	258.7098	288.9884 (219)
Pumps and Fa	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)
Lighting	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685 (231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	65.6368	52.6563	47.4112	34.7354	26.8307	21.9209	24.4758	31.8146	41.3240	54.2194	61.2406	67.4611 (232)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-79.9306	-103.1912	-140.5351	-153.1274	-157.4642	-146.3133	-144.3089	-140.0537	-130.8182	-118.0135	-86.1137	-69.2111 (233a)
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	-61.7164	-117.1523	-224.5332	-349.9154	-448.3224	-475.1614	-462.2158	-392.2951	-288.5673	-176.3275	-81.6184	-48.1610 (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												4699.9190 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												674.8602 (215)
Efficiency of water heater												87.3000
Water heating fuel used												2945.9756 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												529.7268 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4595.0671 (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												4341.4144 (238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4699.9190	3.5000	164.4972 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	674.8602	6.3000	42.5162 (242)
Water heating (other fuel)	2945.9756	3.5000	103.1091 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154 (249)
Energy for lighting	529.7268	18.3900	97.4168 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1469.0809	18.3900	-270.1640
PV Unit electricity exported	-3125.9861	5.8100	-181.6198
Total			-451.7838 (252)
Total energy cost			65.5709 (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	4699.9190	0.2100	986.9830 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	674.8602	0.0280	18.8961 (263)
Water heating (other fuel)	2945.9756	0.2100	618.6549 (264)
Space and water heating			1624.5339 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	529.7268	0.1443	76.4559 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1469.0809	0.1356	-199.2798
PV Unit electricity exported	-3125.9861	0.1260	-393.7505
Total			-593.0303 (269)
Total CO2, kg/year			1119.8888 (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	4699.9190	1.1300	5310.9084 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	674.8602	1.0460	705.9037 (277)
Water heating (other fuel)	2945.9756	1.1300	3328.9524 (278)
Space and water heating			9345.7646 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	529.7268	1.5338	812.5126 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1469.0809	1.5014	-2205.6622
PV Unit electricity exported	-3125.9861	0.4623	-1445.2402
Total			-3650.9024 (283)
Total Primary energy kWh/year			6637.4756 (286)

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Property Reference	RC-High Fields Cambridge-HTA		Issued on Date	17/05/2023	
Assessment Reference	002_HTA-Site 2	Prop Type Ref	DDC584-HTB-Site 1		
Property	42, West Drive, Cambridge, CB23 7NY				
SAP Rating	96 A	DER	9.31	TER	10.64
Environmental	91 B	% DER < TER			12.50
CO ₂ Emissions (t/year)	1.11	DFEE	39.31	TFEE	43.11
Compliance Check	See BREL	% DFEE < TFEE			8.81
% DPER < TPER	1.17	DPER	55.23	TPER	55.89
Assessor Details	Mr. Robert McFarland			Assessor ID	C974-0001
Client					

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.7592 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 = 20.0000 (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	3 * 10 = 30.0000 (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) =	50.0000 / (5) = 0.1442 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3442 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2926 (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	0.3730	0.3657	0.3584	0.3218	0.3145	0.2779	0.2779	0.2706	0.2926	0.3145	0.3291	0.3438 (22b)
Effective ac	0.5696	0.5669	0.5642	0.5518	0.5495	0.5386	0.5386	0.5366	0.5428	0.5495	0.5542	0.5591 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)

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Rafter	36.9000	0.4700	36.4300	0.1100	4.0073	(30)
Total net area of external elements Aum(A, m2)			324.7900			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	61.7915		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)

Point Thermal bridges 0.0000 (36a) =
 Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	65.1764	64.8672	64.5642	63.1409	62.8746	61.6350	61.6350	61.4055	62.1125	62.8746	63.4133	63.9765 (38)
Average = Sum(39)m / 12 =	148.0023	147.6932	147.3902	145.9669	145.7006	144.4610	144.4610	144.2315	144.9385	145.7006	146.2393	146.8025 (39)
												145.9657

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0306	1.0284	1.0263	1.0164	1.0146	1.0059	1.0059	1.0043	1.0093	1.0146	1.0183	1.0222 (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													2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)	
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)	
Average daily hot water use (litres/day)													125.1081 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)

Water storage loss:
 Total storage loss 0.0000 (56)

If cylinder contains dedicated solar storage
 Primary loss 0.0000 (57)
 Combi loss 0.0000 (59)

Total heat required for water heating calculated for each month 255.7839 (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 258.7069 (64)
 Total per year (kWh/year) = Sum(64)m = 2589.2433 (64)

Electric shower(s) 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 81.4558 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372 (68)
Pumps, fans	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Total internal gains	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836 (72)
	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	10.9900	19.6403	0.5700	0.7000	0.7700	59.6831 (76)
South	2.6600	46.7521	0.5700	0.7000	0.7700	34.3865 (78)
West	7.3400	19.6403	0.5700	0.7000	0.7700	39.8611 (80)
East	0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)

Solar gains	138.4214	260.1247	408.1160	572.8290	688.1851	699.7603	668.0453	582.0551	466.5378	302.7713	170.5317	115.2327 (83)
Total gains	913.9699	1029.0158	1146.7044	1261.0077	1326.0705	1292.0076	1237.8785	1159.4076	1073.3955	960.0771	881.6725	871.0533 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	0.9999	0.9997	0.9984	0.9867	0.9115	0.7062	0.5130	0.5709	0.8676	0.9945	0.9997	1.0000 (86)
MIT	20.2781	20.3746	20.5399	20.7577	20.9321	20.9944	20.9997	20.9993	20.9681	20.7398	20.4657	20.2600 (87)
Th 2	20.0579	20.0597	20.0615	20.0697	20.0712	20.0784	20.0784	20.0797	20.0756	20.0712	20.0681	20.0648 (88)
util rest of house	0.9999	0.9995	0.9973	0.9770	0.8603	0.6100	0.4059	0.4576	0.7828	0.9890	0.9995	0.9999 (89)
MIT 2	19.2145	19.3397	19.5526	19.8324	20.0242	20.0765	20.0784	20.0796	20.0602	19.8148	19.4636	19.1970 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.4218 (91)
MIT	19.6631	19.7762	19.9690	20.2227	20.4072	20.4636	20.4670	20.4675	20.4431	20.2049	19.8862	19.6453 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5131	19.6262	19.8190	20.0727	20.2572	20.3136	20.3170	20.3175	20.2931	20.0549	19.7362	19.4953 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9998	0.9994	0.9969	0.9770	0.8720	0.6352	0.4337	0.4870	0.8051	0.9888	0.9994	0.9999 (94)
Useful gains	913.8195	1028.4193	1143.1484	1232.0611	1156.3824	820.6932	536.8242	564.6622	864.2100	949.3612	881.1565	870.9614 (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	2251.5699	2174.9600	1963.0963	1630.8378	1246.7823	825.3915	536.9546	565.0251	897.6232	1377.5852	1847.9144	2245.3930 (97)
Space heating kWh	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98a)
Space heating requirement - total per year (kWh/year)												4767.4210
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	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4767.4210
Space heating per m2										(98c) / (4) =		33.1970 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												84.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1066.3782	825.5093	653.6156	307.6277	72.0616	0.0000	0.0000	0.0000	0.0000	341.3557	745.7847	1095.6183 (211)
Space heating efficiency (main heating system 2)												

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Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
	153.1210	118.5347	93.8525	44.1722	10.3473	0.0000	0.0000	0.0000	0.0000	0.0000	49.0152	107.0870	157.3196	(215)
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839		(64)
Efficiency of water heater (217)m	88.6133	88.5726	88.4727	88.2258	87.6822	87.3000	87.3000	87.3000	87.3000	88.2652	88.5389	87.3000		(216)
Fuel for water heating, kWh/month	291.9504	257.9401	273.7294	240.2574	233.5215	210.4807	207.2592	216.0728	219.0586	242.5907	258.3125	288.6148		(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041		(231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149		(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-73.1218	-99.7230	-138.3470	-149.2853	-155.2263	-142.6451	-141.1696	-136.6032	-126.8012	-111.8228	-79.3371	-63.6268		(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-52.0945	-109.2269	-217.5186	-327.6448	-433.9807	-436.6392	-430.4593	-362.8318	-264.3566	-155.2919	-69.1874	-41.1578		(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														5107.9511 (211)
Space heating fuel - main system 2														0.0000 (213)
Space heating fuel - secondary														733.4494 (215)
Efficiency of water heater														87.3000 (216)
Water heating fuel used														2939.7882 (219)
Space cooling fuel														0.0000 (221)
Electricity for pumps and fans:														
central heating pump														41.0000 (230c)
main heating flue fan														45.0000 (230e)
Total electricity for the above, kWh/year														86.0000 (231)
Electricity for lighting (calculated in Appendix L)														564.7001 (232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation														-4318.0985 (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														5113.7903 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5107.9511	3.6400	185.9294 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	733.4494	5.1200	37.5526 (242)
Water heating (other fuel)	2939.7882	3.6400	107.0083 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814 (249)
Energy for lighting	564.7001	16.4900	93.1190 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	16.4900	-233.7802
PV Unit electricity exported	-2900.3893	5.5900	-162.1318
Total			-395.9120 (252)
Total energy cost			133.8788 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2555 (257)
SAP value		95.8578
SAP rating (Section 12)		96 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5107.9511	0.2100	1072.6697 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	733.4494	0.0280	20.5366 (263)
Water heating (other fuel)	2939.7882	0.2100	617.3555 (264)
Space and water heating			1710.5618 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	0.1354	-191.9948
PV Unit electricity exported	-2900.3893	0.1259	-365.0822
Total			-557.0770 (269)
Total CO2, kg/year			1246.9178 (272)
CO2 emissions per m2			8.6800 (273)
EI value			91.1411
EI rating			91 (274)
EI band			B

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	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 346.7592 (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	1 * 20 = 20.0000 (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	3 * 10 = 30.0000 (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) =	50.0000 / (5) = 0.1442 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3442 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2926 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3438	0.3291	0.3291	0.2999	0.2926	0.2560	0.2633	0.2706	0.2779	0.2852	0.2926	0.3072 (22b)
Effective ac	0.5591	0.5542	0.5542	0.5450	0.5428	0.5328	0.5347	0.5366	0.5386	0.5407	0.5428	0.5472 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)

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Heatloss Floor 1			73.7700	0.1300	9.5901	(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512	(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600	(29a)
Loft	45.5200		45.5200	0.1100	5.0072	(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073	(30)
Total net area of external elements Aum(A, m2)			324.7900			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.7915	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	63.9765	63.4133	63.4133	62.3604	62.1125	60.9647	61.1820	61.4055	61.6350	61.8707	62.1125	62.6145 (38)
Average = Sum(39)m / 12 =	146.8025	146.2393	146.2393	145.1864	144.9385	143.7907	144.0080	144.2315	144.4610	144.6967	144.9385	145.4405 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0222	1.0183	1.0183	1.0110	1.0093	1.0013	1.0028	1.0043	1.0059	1.0076	1.0093	1.0127 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

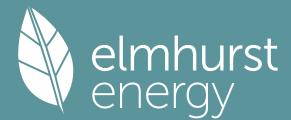
4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)	
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)	
Average daily hot water use (litres/day)													125.1081 (43)
Daily hot water use	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)	
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)	
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)	
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440 (61)	
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)	
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558 (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
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(66)m	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609	82.1609	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372	447.2372	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	(71)
Water heating gains (Table 5)	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836	109.4836	(72)
Total internal gains	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205	755.8205	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W							
East	10.9900	22.4348	0.5700	0.7000	0.7000	0.7700	68.1751 (76)							
South	2.6600	51.9047	0.5700	0.7000	0.7000	0.7700	38.1763 (78)							
West	7.3400	22.4348	0.5700	0.7000	0.7000	0.7700	45.5328 (80)							
East	0.4700	30.5536	0.5700	0.7000	0.7000	1.0000	5.1567 (82)							
Solar gains	157.0409	275.0270	419.4716	604.7891	707.7972	750.8134	708.9781	620.8426	500.9781	334.4299	193.1337	129.4576	129.4576	(83)
Total gains	932.5893	1043.9181	1158.0600	1292.9679	1345.6826	1343.0607	1278.8113	1198.1951	1107.8359	991.7357	904.2744	885.2781	885.2781	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	122.2816	122.7525	122.7525	123.6428	123.8543	124.8429	124.6545	124.4614	124.2636	124.0612	123.8543	123.4268	
tau	9.1521	9.1835	9.1835	9.2429	9.2570	9.3229	9.3103	9.2974	9.2842	9.2707	9.2570	9.2285	
util living area	0.9999	0.9996	0.9978	0.9784	0.8707	0.5975	0.3941	0.4212	0.7634	0.9879	0.9996	0.9999	(86)
MIT	20.3089	20.4052	20.5793	20.8053	20.9585	20.9987	21.0000	21.0000	20.9902	20.8031	20.5042	20.2899	(87)
Th 2	20.0648	20.0681	20.0681	20.0742	20.0756	20.0823	20.0810	20.0797	20.0784	20.0770	20.0756	20.0727	(88)
util rest of house	0.9998	0.9994	0.9962	0.9632	0.8060	0.5009	0.2906	0.3105	0.6573	0.9760	0.9993	0.9999	(89)
MIT 2	19.2598	19.3859	19.6084	19.8928	20.0594	20.0820	20.0810	20.0797	20.0751	19.8969	19.5191	19.2419	(90)
Living area fraction	f _{LA} = Living area / (4) =												
MIT	19.7023	19.8158	20.0179	20.2777	20.4334	20.4686	20.4686	20.4678	20.4611	20.2791	19.9346	19.6839	(91)
Temperature adjustment	-0.1500												
adjusted MIT	19.5523	19.6658	19.8679	20.1277	20.2834	20.3186	20.3186	20.3178	20.3111	20.1291	19.7846	19.5339	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9993	0.9958	0.9643	0.8220	0.5260	0.3174	0.3392	0.6854	0.9769	0.9991	0.9999	(94)
Useful gains	932.3885	1043.1560	1153.1644	1246.8063	1106.2034	706.4035	405.8957	406.4109	759.2747	968.8278	903.4874	885.1597	(95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000	(96)
Heat loss rate W	2209.7133	2130.0938	1896.4170	1557.5112	1157.1027	707.2522	405.9020	406.4225	767.2459	1277.5432	1795.0052	2201.0873	(97)
Space heating kWh	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501	(98a)
Space heating requirement - total per year (kWh/year)	4345.9355												
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	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4345.9355												
Space heating per m2	(98c) / (4) = 30.2621 (99)												

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)												
Fraction of space heat from main system(s)	0.9000 (202)												
Efficiency of main space heating system 1 (in %)	84.0000 (206)												
Efficiency of main space heating system 2 (in %)	0.0000 (207)												
Efficiency of secondary/supplementary heating system, %	65.0000 (208)												
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating efficiency (main heating system 1)	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501	(98)

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Space heating fuel (main heating system)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating efficiency (main heating system 2)	1018.2104	782.5952	592.4785	239.6866	40.5740	0.0000	0.0000	0.0000	0.0000	246.0903	687.7423	1048.9823	(211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Water heating requirement	146.2046	112.3726	85.0738	34.4165	5.8260	0.0000	0.0000	0.0000	0.0000	35.3360	98.7527	150.6231	(215)
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	(64)
Efficiency of water heater (217)m	88.5993	88.5553	88.4363	88.1199	87.5386	87.3000	87.3000	87.3000	87.3000	88.1268	88.5112	88.6118	(216)
Fuel for water heating, kWh/month	291.9965	257.9906	273.8420	240.5460	233.9044	210.4807	207.2592	216.0728	219.0586	242.9716	258.3934	288.6567	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.8732	-103.0430	-140.1747	-152.4889	-156.5827	-145.3872	-143.4839	-139.4806	-130.5122	-117.8838	-86.0664	-69.1794	(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	-61.7738	-117.3004	-224.8936	-350.5540	-449.2039	-476.0874	-463.0408	-392.8682	-288.8733	-176.4572	-81.6658	-48.1928	(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												4656.3595	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												668.6055	(215)
Efficiency of water heater												87.3000	(216)
Water heating fuel used												2941.1725	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												564.7001	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4595.0671	(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												4321.7704	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4656.3595	3.5000	162.9726 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	668.6055	6.3000	42.1221 (242)
Water heating (other fuel)	2941.1725	3.5000	102.9410 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154 (249)
Energy for lighting	564.7001	18.3900	103.8483 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	18.3900	-269.2583
PV Unit electricity exported	-3130.9110	5.8100	-181.9059
Total			-451.1642 (252)
Total energy cost			70.5353 (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	4656.3595	0.2100	977.8355 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	668.6055	0.0280	18.7210 (263)

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Water heating (other fuel)	2941.1725	0.2100	617.6462 (264)
Space and water heating			1614.2027 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	0.1357	-198.6497
PV Unit electricity exported	-3130.9110	0.1260	-394.3576
Total			-593.0073 (269)
Total CO2, kg/year			1114.6283 (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	4656.3595	1.1300	5261.6862 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	668.6055	1.0460	699.3613 (277)
Water heating (other fuel)	2941.1725	1.1300	3323.5249 (278)
Space and water heating			9284.5724 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	564.7001	1.5338	866.1558 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	1.5015	-2198.4108
PV Unit electricity exported	-3130.9110	0.4623	-1447.4681
Total			-3645.8790 (283)
Total Primary energy kWh/year			6634.9501 (286)

 SAP 10 EPC IMPROVEMENTS

002_HTA-Site 2

Current energy efficiency rating: A 96
 Current environmental impact rating: B 91

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

Recommended measures:
 (none) SAP change Cost change CO2 change

Measures omitted - SAP change or cost saving too small:
 N Solar water heating + 0.4 -£ 15 -153 kg (13.7%)

Recommended measures
 (none) Typical annual savings Energy Environmental
 Total Savings £0 0.00 kg/m² efficiency impact

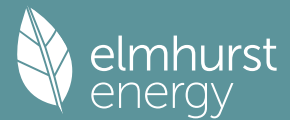
Potential energy efficiency rating: A 96
 Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£120	£120	£0
Mains gas	£360	£360	£0
Wood	£42	£42	£0
Space heating	£315	£315	£0
Water heating	£103	£103	£0
Lighting	£104	£104	£0
Generated (PV)	-£451	-£451	£0
Total cost of fuels	£71	£71	£0
Total cost of uses	£71	£71	£0
Delivered energy	30 kWh/m ²	30 kWh/m ²	0 kWh/m ²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m ²	8 kg/m ²	8 kg/m ²	0 kg/m ²
Primary energy	46 kWh/m ²	46 kWh/m ²	0 kWh/m ²

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	346.7592 (5)

2. Ventilation rate

	Value	Reference
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	1 * 20 =	20.0000 (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	3 * 10 =	30.0000 (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) =	50.0000 / (5) =	0.1442 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.3442	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2926 (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	0.3730	0.3657	0.3584	0.3218	0.3145	0.2779	0.2779	0.2706	0.2926	0.3145	0.3291	0.3438 (22b)
Effective ac	0.5696	0.5669	0.5642	0.5518	0.5495	0.5386	0.5386	0.5366	0.5428	0.5495	0.5542	0.5591 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073		(30)
Total net area of external elements Aum(A, m ²)			324.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.7915	(33)

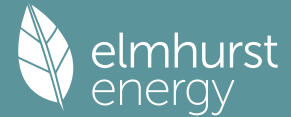
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K

450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

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Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)
 Point Thermal bridges 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	65.1764	64.8672	64.5642	63.1409	62.8746	61.6350	61.6350	61.4055	62.1125	62.8746	63.4133	63.9765 (38)
Average = Sum(39)m / 12 =	148.0023	147.6932	147.3902	145.9669	145.7006	144.4610	144.4610	144.2315	144.9385	145.7006	146.2393	146.8025 (39)
												145.9657

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0306	1.0284	1.0263	1.0164	1.0146	1.0059	1.0059	1.0043	1.0093	1.0146	1.0183	1.0222 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42)
Hot water usage for baths	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)
Average daily hot water use (litres/day)												125.1081 (43)
Daily hot water use	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)
Energy conte	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)
Energy content (annual)												Total = Sum(45)m = 2077.6008
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440 (59)
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (62)
WWHS	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)
FGHS	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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Electric shower(s)												
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558 (65)

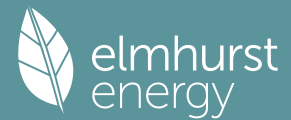
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Water heating gains (Table 5)	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836 (72)
Total internal gains	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	10.9900	19.6403	0.5700	0.7000	0.7700	59.6831 (76)
South	2.6600	46.7521	0.5700	0.7000	0.7700	34.3865 (78)
West	7.3400	19.6403	0.5700	0.7000	0.7700	39.8611 (80)

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East	0.4700	26.6072	0.5700	0.7000	1.0000	4.4907 (82)						
Solar gains	138.4214	260.1247	408.1160	572.8290	688.1851	699.7603	668.0453	582.0551	466.5378	302.7713	170.5317	115.2327 (83)
Total gains	913.9699	1029.0158	1146.7044	1261.0077	1326.0705	1292.0076	1237.8785	1159.4076	1073.3955	960.0771	881.6725	871.0533 (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	121.2903	121.5442	121.7941	122.9816	123.2064	124.2636	124.2636	124.4614	123.8543	123.2064	122.7525	122.2816
alpha	9.0860	9.1029	9.1196	9.1988	9.2138	9.2842	9.2842	9.2974	9.2570	9.2138	9.1835	9.1521
util living area	0.9999	0.9997	0.9984	0.9867	0.9115	0.7062	0.5130	0.5709	0.8676	0.9945	0.9997	1.0000 (86)
MIT	20.2781	20.3746	20.5399	20.7577	20.9321	20.9944	20.9997	20.9993	20.9681	20.7398	20.4657	20.2600 (87)
Th 2	20.0579	20.0597	20.0615	20.0697	20.0712	20.0784	20.0784	20.0797	20.0756	20.0712	20.0681	20.0648 (88)
util rest of house	0.9999	0.9995	0.9973	0.9770	0.8603	0.6100	0.4059	0.4576	0.7828	0.9890	0.9995	0.9999 (89)
MIT 2	19.2145	19.3397	19.5526	19.8324	20.0242	20.0765	20.0784	20.0796	20.0602	19.8148	19.4636	19.1970 (90)
Living area fraction												fLA = Living area / (4) = 0.4218 (91)
MIT	19.6631	19.7762	19.9690	20.2227	20.4072	20.4636	20.4670	20.4675	20.4431	20.2049	19.8862	19.6453 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5131	19.6262	19.8190	20.0727	20.2572	20.3136	20.3170	20.3175	20.2931	20.0549	19.7362	19.4953 (93)

8. Space heating requirement												

Utilisation	0.9998	0.9994	0.9969	0.9770	0.8720	0.6352	0.4337	0.4870	0.8051	0.9888	0.9994	0.9999 (94)
Useful gains	913.8195	1028.4193	1143.1484	1232.0611	1156.3824	820.6932	536.8242	564.6622	864.2100	949.3612	881.1565	870.9614 (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	2251.5699	2174.9600	1963.0963	1630.8378	1246.7823	825.3915	536.9546	565.0251	897.6232	1377.5852	1847.9144	2245.3930 (97)
Space heating kWh	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98a)
Space heating requirement - total per year (kWh/year)												4767.4210
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	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4767.4210
Space heating per m2												(98c) / (4) = 33.1970 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												84.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	995.2863	770.4753	610.0412	287.1192	67.2575	0.0000	0.0000	0.0000	0.0000	318.5986	696.0657	1022.5771 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1066.3782	825.5093	653.6156	307.6277	72.0616	0.0000	0.0000	0.0000	0.0000	341.3557	745.7847	1095.6183 (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)	153.1210	118.5347	93.8525	44.1722	10.3473	0.0000	0.0000	0.0000	0.0000	49.0152	107.0870	157.3196 (215)
Water heating												
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Efficiency of water heater (217)m	88.6133	88.5726	88.4727	88.2258	87.6822	87.3000	87.3000	87.3000	87.3000	88.2652	88.5389	87.3000 (216)
Fuel for water heating, kWh/month	291.9504	257.9401	273.7294	240.2574	233.5215	210.4807	207.2592	216.0728	219.0586	242.5907	258.3125	288.6148 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685 (231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-73.1218	-99.7230	-138.3470	-149.2853	-155.2263	-142.6451	-141.1696	-136.6032	-126.8012	-111.8228	-79.3371	-63.6268 (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)												

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(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-52.0945	-109.2269	-217.5186	-327.6448	-433.9807	-436.6392	-430.4593	-362.8318	-264.3566	-155.2919	-69.1874	-41.1578	(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													5107.9511 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													733.4494 (215)
Efficiency of water heater													87.3000
Water heating fuel used													2939.7882 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													86.0000 (231)
Electricity for lighting (calculated in Appendix L)													564.7001 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4318.0985 (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													5113.7903 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5107.9511	3.6400	185.9294 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	733.4494	5.1200	37.5526 (242)
Water heating (other fuel)	2939.7882	3.6400	107.0083 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814 (249)
Energy for lighting	564.7001	16.4900	93.1190 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	16.4900	-233.7802
PV Unit electricity exported	-2900.3893	5.5900	-162.1318
Total			-395.9120 (252)
Total energy cost			133.8788 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2555 (257)
SAP value		95.8578
SAP rating (Section 12)		96 (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	5107.9511	0.2100	1072.6697 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	733.4494	0.0280	20.5366 (263)
Water heating (other fuel)	2939.7882	0.2100	617.3555 (264)
Space and water heating			1710.5618 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	0.1354	-191.9948
PV Unit electricity exported	-2900.3893	0.1259	-365.0822
Total			-557.0770 (269)
Total CO2, kg/year			1246.9178 (272)
CO2 emissions per m2			8.6800 (273)
EI value			91.1411
EI rating			91 (274)
EI band			B

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.7592 (5)

2. Ventilation rate

		m ³ per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 =	20.0000 (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	3 * 10 =	30.0000 (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) =	50.0000 / (5) =	0.1442 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.3442	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2926 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3438	0.3291	0.3291	0.2999	0.2926	0.2560	0.2633	0.2706	0.2779	0.2852	0.2926	0.3072 (22b)
Effective ac	0.5591	0.5542	0.5542	0.5450	0.5428	0.5328	0.5347	0.5366	0.5386	0.5407	0.5428	0.5472 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073		(30)
Total net area of external elements Aum(A, m ²)			324.7900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.7915		(33)

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

450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560

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R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			21.0345 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			82.8260 (37) (33) + (36) + (36a) =

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	63.9765	63.4133	63.4133	62.3604	62.1125	60.9647	61.1820	61.4055	61.6350	61.8707	62.1125	62.6145 (38)
Average = Sum(39)m / 12 =	146.8025	146.2393	146.2393	145.1864	144.9385	143.7907	144.0080	144.2315	144.4610	144.6967	144.9385	145.4405 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0222	1.0183	1.0183	1.0110	1.0093	1.0013	1.0028	1.0043	1.0059	1.0076	1.0093	1.0127 (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													2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338	88.6338 (42b)
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171	46.9171 (42c)
Average daily hot water use (litres/day)													125.1081 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509	135.5509 (44)
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399	212.2399 (45)
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360	31.8360 (46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440	43.5440 (61)
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	255.7839 (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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	255.7839 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558	81.4558 (65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609	82.1609 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372	447.2372 (68)
Pumps, fans	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Total internal gains	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836	109.4836 (72)
	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205	755.8205 (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	

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East	10.9900	22.4348	0.5700	0.7000	0.7700	68.1751 (76)
South	2.6600	51.9047	0.5700	0.7000	0.7700	38.1763 (78)
West	7.3400	22.4348	0.5700	0.7000	0.7700	45.5328 (80)
East	0.4700	30.5536	0.5700	0.7000	1.0000	5.1567 (82)

Solar gains	157.0409	275.0270	419.4716	604.7891	707.7972	750.8134	708.9781	620.8426	500.9781	334.4299	193.1337	129.4576 (83)
Total gains	932.5893	1043.9181	1158.0600	1292.9679	1345.6826	1343.0607	1278.8113	1198.1951	1107.8359	991.7357	904.2744	885.2781 (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	122.2816	122.7525	122.7525	123.6428	123.8543	124.8429	124.6545	124.4614	124.2636	124.0612	123.8543	123.4268
alpha	9.1521	9.1835	9.1835	9.2429	9.2570	9.3229	9.3103	9.2974	9.2842	9.2707	9.2570	9.2285
util living area	0.9999	0.9996	0.9978	0.9784	0.8707	0.5975	0.3941	0.4212	0.7634	0.9879	0.9996	0.9999 (86)
MIT	20.3089	20.4052	20.5793	20.8053	20.9585	20.9987	21.0000	21.0000	20.9902	20.8031	20.5042	20.2899 (87)
Th 2	20.0648	20.0681	20.0681	20.0742	20.0756	20.0823	20.0810	20.0797	20.0784	20.0770	20.0756	20.0727 (88)
util rest of house	0.9998	0.9994	0.9962	0.9632	0.8060	0.5009	0.2906	0.3105	0.6573	0.9760	0.9993	0.9999 (89)
MIT 2	19.2598	19.3859	19.6084	19.8928	20.0504	20.0820	20.0810	20.0797	20.0751	19.8969	19.5191	19.2419 (90)
Living area fraction										fLA = Living area / (4) =		0.4218 (91)
MIT	19.7023	19.8158	20.0179	20.2777	20.4334	20.4686	20.4686	20.4678	20.4611	20.2791	19.9346	19.6839 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5523	19.6658	19.8679	20.1277	20.2834	20.3186	20.3186	20.3178	20.3111	20.1291	19.7846	19.5339 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9998	0.9993	0.9958	0.9643	0.8220	0.5260	0.3174	0.3392	0.6854	0.9769	0.9991	0.9999 (94)
Useful gains	932.3885	1043.1560	1153.1644	1246.8063	1106.2034	706.4035	405.8957	406.4109	759.2747	968.8278	903.4874	885.1597 (95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000 (96)
Heat loss rate W	2209.7133	2130.0938	1896.4170	1557.5112	1157.1027	707.2522	405.9020	406.4225	767.2459	1277.5432	1795.0052	2201.0873 (97)
Space heating kWh	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501 (98a)
Space heating requirement - total per year (kWh/year)												4345.9355
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	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4345.9355
Space heating per m2												(98c) / (4) = 30.2621 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.1000 (201)

Fraction of space heat from main system(s) 0.9000 (202)

Efficiency of main space heating system 1 (in %) 84.0000 (206)

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

Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	950.3297	730.4222	552.9799	223.7075	37.8691	0.0000	0.0000	0.0000	0.0000	229.6842	641.8928	979.0501 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1018.2104	782.5952	592.4785	239.6866	40.5740	0.0000	0.0000	0.0000	0.0000	246.0903	687.7423	1048.9823 (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)	146.2046	112.3726	85.0738	34.4165	5.8260	0.0000	0.0000	0.0000	0.0000	35.3360	98.7527	150.6231 (215)
Water heating												
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Efficiency of water heater (217)m	88.5993	88.5553	88.4363	88.1199	87.5386	87.3000	87.3000	87.3000	87.3000	88.1268	88.5112	87.3000 (216)
Fuel for water heating, kWh/month	291.9965	257.9906	273.8420	240.5460	233.9044	210.4807	207.2592	216.0728	219.0586	242.9716	258.3934	288.6567 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.8732	-103.0430	-140.1747	-152.4889	-156.5827	-145.3872	-143.4839	-139.4806	-130.5122	-117.8838	-86.0664	-69.1794 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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	-61.7738	-117.3004	-224.8936	-350.5540	-449.2039	-476.0874	-463.0408	-392.8682	-288.8733	-176.4572	-81.6658	-48.1928	(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												4656.3595	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												668.6055	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2941.1725	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												564.7001	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4595.0671	(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												4321.7704	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4656.3595	3.5000	162.9726	(240)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	668.6055	6.3000	42.1221	(242)
Water heating (other fuel)	2941.1725	3.5000	102.9410	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154	(249)
Energy for lighting	564.7001	18.3900	103.8483	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1464.1561	18.3900	-269.2583	
PV Unit electricity exported	-3130.9110	5.8100	-181.9059	
Total			-451.1642	(252)
Total energy cost			70.5353	(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	4656.3595	0.2100	977.8355	(261)
Total CO2 associated with community systems			0.0000	(373)
Space heating - secondary	668.6055	0.0280	18.7210	(263)
Water heating (other fuel)	2941.1725	0.2100	617.6462	(264)
Space and water heating			1614.2027	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	564.7001	0.1443	81.5037	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1464.1561	0.1357	-198.6497	
PV Unit electricity exported	-3130.9110	0.1260	-394.3576	
Total			-593.0073	(269)
Total CO2, kg/year			1114.6283	(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	4656.3595	1.1300	5261.6862	(275)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	668.6055	1.0460	699.3613	(277)
Water heating (other fuel)	2941.1725	1.1300	3323.5249	(278)
Space and water heating			9284.5724	(279)

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Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	564.7001	1.5338	866.1558 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	1.5015	-2198.4108
PV Unit electricity exported	-3130.9110	0.4623	-1447.4681
Total			-3645.8790 (283)
Total Primary energy kWh/year			6634.9501 (286)

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Property Reference	RC-High Fields Cambridge-HTA-2		Issued on Date	17/05/2023	
Assessment Reference	002_HTA-Site 3	Prop Type Ref	DDC584-HTB-Site 1		
Property	42, West Drive, Cambridge, CB23 7NY				
SAP Rating	96 A	DER	9.65	TER	11.00
Environmental	91 B	% DER < TER			12.27
CO ₂ Emissions (t/year)	1.16	DFEE	40.64	TFEE	44.58
Compliance Check	See BREL	% DFEE < TFEE			8.84
% DPER < TPER	1.09	DPER	57.23	TPER	57.86
Assessor Details	Mr. Robert McFarland			Assessor ID	C974-0001
Client					

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	346.7592 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 = 20.0000 (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	3 * 10 = 30.0000 (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) =	50.0000 / (5) = 0.1442 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3442 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2926 (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	0.3730	0.3657	0.3584	0.3218	0.3145	0.2779	0.2779	0.2706	0.2926	0.3145	0.3291	0.3438 (22b)
Effective ac	0.5696	0.5669	0.5642	0.5518	0.5495	0.5386	0.5386	0.5366	0.5428	0.5495	0.5542	0.5591 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)

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Rafter	36.9000	0.4700	36.4300	0.1100	4.0073	(30)
Total net area of external elements Aum(A, m2)			324.7900			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	61.7915		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)

Point Thermal bridges 0.0000 (36a) =
 Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	65.1764	64.8672	64.5642	63.1409	62.8746	61.6350	61.6350	61.4055	62.1125	62.8746	63.4133	63.9765 (38)
Average = Sum(39)m / 12 =	148.0023	147.6932	147.3902	145.9669	145.7006	144.4610	144.4610	144.2315	144.9385	145.7006	146.2393	146.8025 (39)
												145.9657

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0306	1.0284	1.0263	1.0164	1.0146	1.0059	1.0059	1.0043	1.0093	1.0146	1.0183	1.0222 (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													2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)	
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)	
Average daily hot water use (litres/day)													125.1081 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)

Water storage loss:
 Total storage loss 0.0000 (56)

If cylinder contains dedicated solar storage
 Primary loss 0.0000 (57)
 Combi loss 0.0000 (59)

Total heat required for water heating calculated for each month 255.7839 (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 258.7069 (64)
 Total per year (kWh/year) = Sum(64)m = 2589.2433 (64)

Electric shower(s) 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 81.4558 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372 (68)
Pumps, fans	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Total internal gains	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836 (72)
	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	10.9900	11.2829	0.5700	0.7000	0.7700	34.2867 (75)
Southwest	7.3400	36.7938	0.5700	0.7000	0.7700	74.6753 (79)
Northwest	2.6600	11.2829	0.5700	0.7000	0.7700	8.2987 (81)
Northeast	0.4700	18.0708	0.5700	0.7000	1.0000	3.0499 (82)

Solar gains	120.3107	220.2909	342.2037	492.3813	613.9176	636.9301	602.6443	507.7758	393.5484	254.4669	146.9012	101.1512 (83)
Total gains	895.8592	989.1820	1080.7921	1180.5601	1251.8030	1229.1774	1172.4775	1085.1282	1000.4062	911.7728	858.0419	856.9718 (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, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	121.2903	121.5442	121.7941	122.9816	123.2064	124.2636	124.2636	124.4614	123.8543	123.2064	122.7525	122.2816
alpha	9.0860	9.1029	9.1196	9.1988	9.2138	9.2842	9.2842	9.2974	9.2570	9.2138	9.1835	9.1521
util living area	0.9999	0.9998	0.9990	0.9917	0.9338	0.7382	0.5413	0.6089	0.9024	0.9963	0.9998	1.0000 (86)
MIT	20.2697	20.3562	20.5097	20.7236	20.9136	20.9920	20.9995	20.9988	20.9548	20.7182	20.4548	20.2535 (87)
Th 2	20.0579	20.0597	20.0615	20.0697	20.0712	20.0784	20.0784	20.0797	20.0756	20.0712	20.0681	20.0648 (88)
util rest of house	0.9999	0.9997	0.9983	0.9853	0.8900	0.6400	0.4285	0.4888	0.8261	0.9924	0.9996	0.9999 (89)
MIT 2	19.2037	19.3161	19.5142	19.7914	20.0083	20.0755	20.0783	20.0795	20.0520	19.7882	19.4495	19.1886 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.4218 (91)
MIT	19.6533	19.7548	19.9341	20.1846	20.3901	20.4621	20.4669	20.4672	20.4328	20.1804	19.8735	19.6377 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5033	19.6048	19.7841	20.0346	20.2401	20.3121	20.3169	20.3172	20.2828	20.0304	19.7235	19.4877 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9999	0.9996	0.9980	0.9850	0.8994	0.6658	0.4578	0.5201	0.8460	0.9922	0.9995	0.9999 (94)
Useful gains	895.7340	988.7628	1078.6408	1162.8149	1125.8214	818.3530	536.7359	564.3589	846.2947	904.6546	857.6378	856.8928 (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	2250.1256	2171.7961	1957.9403	1625.2801	1244.3023	825.1728	536.9425	564.9868	896.1196	1374.0224	1846.0543	2244.2777 (97)
Space heating kWh	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98a)
Space heating requirement - total per year (kWh/year)												4971.0732
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	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4971.0732
Space heating per m2										(98c) / (4) =		34.6151 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												84.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1079.6436	851.7840	700.9273	356.7589	94.4462	0.0000	0.0000	0.0000	0.0000	374.1532	762.4927	1105.9440 (211)
Space heating efficiency (main heating system 2)												

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Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
	155.0258	122.3074	100.6460	51.2269	13.5615	0.0000	0.0000	0.0000	0.0000	0.0000	53.7246	109.4861	158.8022	(215)
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	255.7839	(64)
Efficiency of water heater (217)m	88.6170	88.5825	88.4977	88.2877	87.7682	87.3000	87.3000	87.3000	87.3000	88.3032	88.5463	87.3000	88.6274	(216)
Fuel for water heating, kWh/month	291.9383	257.9112	273.6519	240.0888	233.2926	210.4807	207.2592	216.0728	219.0586	242.4863	258.2909	288.6059	288.6059	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149	71.9149	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-73.1218	-99.7230	-138.3470	-149.2853	-155.2263	-142.6451	-141.1696	-136.6032	-126.8012	-111.8228	-79.3371	-63.6268	-63.6268	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-52.0945	-109.2269	-217.5186	-327.6448	-433.9807	-436.6392	-430.4593	-362.8318	-264.3566	-155.2919	-69.1874	-41.1578	-41.1578	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													5326.1499	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													764.7805	(215)
Efficiency of water heater													87.3000	(216)
Water heating fuel used													2939.1371	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
central heating pump													41.0000	(230c)
main heating flue fan													45.0000	(230e)
Total electricity for the above, kWh/year													86.0000	(231)
Electricity for lighting (calculated in Appendix L)													564.7001	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-4318.0985	(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													5362.6691	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5326.1499	3.6400	193.8719	(240)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	764.7805	5.1200	39.1568	(242)
Water heating (other fuel)	2939.1371	3.6400	106.9846	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	564.7001	16.4900	93.1190	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1417.7091	16.4900	-233.7802	
PV Unit electricity exported	-2900.3893	5.5900	-162.1318	
Total			-395.9120	(252)
Total energy cost			143.4017	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2737	(257)
SAP value		95.5631	
SAP rating (Section 12)		96	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5326.1499	0.2100	1118.4915 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	764.7805	0.0280	21.4139 (263)
Water heating (other fuel)	2939.1371	0.2100	617.2188 (264)
Space and water heating			1757.1241 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	0.1354	-191.9948
PV Unit electricity exported	-2900.3893	0.1259	-365.0822
Total			-557.0770 (269)
Total CO2, kg/year			1293.4801 (272)
CO2 emissions per m2			9.0100 (273)
EI value			90.8103
EI rating			91 (274)
EI band			B

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	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 346.7592 (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	1 * 20 = 20.0000 (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	3 * 10 = 30.0000 (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) =	50.0000 / (5) = 0.1442 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3442 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2926 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3438	0.3291	0.3291	0.2999	0.2926	0.2560	0.2633	0.2706	0.2779	0.2852	0.2926	0.3072 (22b)
Effective ac	0.5591	0.5542	0.5542	0.5450	0.5428	0.5328	0.5347	0.5366	0.5386	0.5407	0.5428	0.5472 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)

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Heatloss Floor 1			73.7700	0.1300	9.5901	(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512	(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600	(29a)
Loft	45.5200		45.5200	0.1100	5.0072	(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073	(30)
Total net area of external elements Aum(A, m2)			324.7900			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.7915	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 450.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	63.9765	63.4133	63.4133	62.3604	62.1125	60.9647	61.1820	61.4055	61.6350	61.8707	62.1125	62.6145 (38)
Average = Sum(39)m / 12 =	146.8025	146.2393	146.2393	145.1864	144.9385	143.7907	144.0080	144.2315	144.4610	144.6967	144.9385	145.4405 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0222	1.0183	1.0183	1.0110	1.0093	1.0013	1.0028	1.0043	1.0059	1.0076	1.0093	1.0127 (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 2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)	
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)	
Average daily hot water use (litres/day)												125.1081 (43)	

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440 (61)
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (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	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558 (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
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(66)m	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609	82.1609	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372	447.2372	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	(71)
Water heating gains (Table 5)	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836	109.4836	(72)
Total internal gains	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205	755.8205	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W						
Northeast	10.9900	12.9513	0.5700	0.7000	0.7700	39.3566	(75)						
Southwest	7.3400	41.0864	0.5700	0.7000	0.7700	83.3874	(79)						
Northwest	2.6600	12.9513	0.5700	0.7000	0.7700	9.5258	(81)						
Northeast	0.4700	20.8536	0.5700	0.7000	1.0000	3.5196	(82)						
Solar gains	135.7894	232.2401	352.0982	522.2796	635.2257	687.5967	643.4966	544.5646	423.7399	280.6638	165.6103	112.9920	(83)
Total gains	911.3379	1001.1312	1090.6866	1210.4583	1273.1111	1279.8440	1213.3297	1121.9171	1030.5976	937.9697	876.7511	868.8126	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	122.2816	122.7525	122.7525	123.6428	123.8543	124.8429	124.6545	124.4614	124.2636	124.0612	123.8543	123.4268	
alpha	9.1521	9.1835	9.1835	9.2429	9.2570	9.3229	9.3103	9.2974	9.2842	9.2707	9.2570	9.2285	
util living area	0.9999	0.9998	0.9986	0.9862	0.8981	0.6260	0.4153	0.4498	0.8088	0.9920	0.9997	0.9999	(86)
MIT	20.2991	20.3854	20.5486	20.7722	20.9454	20.9981	21.0000	20.9999	20.9846	20.7802	20.4915	20.2823	(87)
Th 2	20.0648	20.0681	20.0681	20.0742	20.0756	20.0823	20.0810	20.0797	20.0784	20.0770	20.0756	20.0727	(88)
util rest of house	0.9999	0.9996	0.9976	0.9758	0.8392	0.5254	0.3063	0.3316	0.7028	0.9835	0.9994	0.9999	(89)
MIT 2	19.2471	19.3605	19.5693	19.8545	20.0407	20.0818	20.0810	20.0797	20.0729	19.8698	19.5028	19.2321	(90)
Living area fraction	fLA = Living area / (4) =												
MIT	19.6908	19.7928	19.9823	20.2416	20.4223	20.4683	20.4686	20.4678	20.4574	20.2538	19.9198	19.6750	(92)
Temperature adjustment	-0.1500												
adjusted MIT	19.5408	19.6428	19.8323	20.0916	20.2723	20.3183	20.3186	20.3178	20.3074	20.1038	19.7698	19.5250	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9995	0.9973	0.9760	0.8534	0.5516	0.3345	0.3622	0.7311	0.9839	0.9993	0.9999	(94)
Useful gains	911.1753	1000.6072	1087.7306	1181.4332	1086.4141	705.9461	405.8910	406.3997	753.4800	922.8350	876.1544	868.7132	(95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000	(96)
Heat loss rate W	2208.0312	2126.7278	1891.2162	1552.2715	1155.4867	707.2037	405.9011	406.4203	766.7104	1273.8793	1792.8592	2199.7941	(97)
Space heating kWh	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242	(98a)
Space heating requirement - total per year (kWh/year)	4549.3294												
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	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4549.3294												
Space heating per m2	(98c) / (4) = 31.6784												

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)	0.1000												
Fraction of space heat from main system(s)	0.9000												
Efficiency of main space heating system 1 (in %)	84.0000												
Efficiency of main space heating system 2 (in %)	0.0000												
Efficiency of secondary/supplementary heating system, %	65.0000												
Space heating requirement	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242	(98)
Space heating efficiency (main heating system 1)													

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Space heating fuel (main heating system)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating efficiency (main heating system 2)	1033.7795	810.8068	640.4928	286.0753	55.0608	0.0000	0.0000	0.0000	0.0000	279.8325	707.1723	1061.0617	(211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Water heating requirement	148.4401	116.4235	91.9682	41.0775	7.9062	0.0000	0.0000	0.0000	0.0000	40.1811	101.5427	152.3576	(215)
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	(64)
Efficiency of water heater (217)m	88.6040	88.5668	88.4653	88.1951	87.6083	87.3000	87.3000	87.3000	87.3000	88.1814	88.5208	88.6152	(216)
Fuel for water heating, kWh/month	291.9812	257.9570	273.7523	240.3410	233.7182	210.4807	207.2592	216.0728	219.0586	242.8211	258.3652	288.6456	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.8732	-103.0430	-140.1747	-152.4889	-156.5827	-145.3872	-143.4839	-139.4806	-130.5122	-117.8838	-86.0664	-69.1794	(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	-61.7738	-117.3004	-224.8936	-350.5540	-449.2039	-476.0874	-463.0408	-392.8682	-288.8733	-176.4572	-81.6658	-48.1928	(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												4874.2815	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												699.8968	(215)
Efficiency of water heater												87.3000	(216)
Water heating fuel used												2940.4531	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												564.7001	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4595.0671	(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												4570.2644	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4874.2815	3.5000	170.5999 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	699.8968	6.3000	44.0935 (242)
Water heating (other fuel)	2940.4531	3.5000	102.9159 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154 (249)
Energy for lighting	564.7001	18.3900	103.8483 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	18.3900	-269.2583
PV Unit electricity exported	-3130.9110	5.8100	-181.9059
Total			-451.1642 (252)
Total energy cost			80.1087 (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	4874.2815	0.2100	1023.5991 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	699.8968	0.0280	19.5971 (263)

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Water heating (other fuel)	2940.4531	0.2100	617.4952 (264)
Space and water heating			1660.6914 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	0.1357	-198.6497
PV Unit electricity exported	-3130.9110	0.1260	-394.3576
Total			-593.0073 (269)
Total CO2, kg/year			1161.1170 (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	4874.2815	1.1300	5507.9381 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	699.8968	1.0460	732.0921 (277)
Water heating (other fuel)	2940.4531	1.1300	3322.7120 (278)
Space and water heating			9562.7422 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	564.7001	1.5338	866.1558 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	1.5015	-2198.4108
PV Unit electricity exported	-3130.9110	0.4623	-1447.4681
Total			-3645.8790 (283)
Total Primary energy kWh/year			6913.1198 (286)

 SAP 10 EPC IMPROVEMENTS

002_HTA-Site 3

Current energy efficiency rating: A 96
 Current environmental impact rating: B 91

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

Recommended measures:
 (none) SAP change Cost change CO2 change

Measures omitted - SAP change or cost saving too small:
 N Solar water heating + 0.4 -£ 15 -152 kg (13.1%)

Recommended measures
 (none) Typical annual savings Energy Environmental
 efficiency impact
 Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: A 96
 Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£120	£120	£0
Mains gas	£368	£368	£0
Wood	£44	£44	£0
Space heating	£325	£325	£0
Water heating	£103	£103	£0
Lighting	£104	£104	£0
Generated (PV)	-£451	-£451	£0
Total cost of fuels	£81	£81	£0
Total cost of uses	£81	£81	£0
Delivered energy	32 kWh/m ²	32 kWh/m ²	0 kWh/m ²
Carbon dioxide emissions	1.2 tonnes	1.2 tonnes	0.0 tonnes
CO2 emissions per m ²	8 kg/m ²	8 kg/m ²	0 kg/m ²
Primary energy	48 kWh/m ²	48 kWh/m ²	0 kWh/m ²

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	346.7592 (5)

2. Ventilation rate

	Value	Reference
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	1 * 20 =	20.0000 (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	3 * 10 =	30.0000 (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) =	50.0000 / (5) =	0.1442 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.3442	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2926 (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	0.3730	0.3657	0.3584	0.3218	0.3145	0.2779	0.2779	0.2706	0.2926	0.3145	0.3291	0.3438 (22b)
Effective ac	0.5696	0.5669	0.5642	0.5518	0.5495	0.5386	0.5386	0.5366	0.5428	0.5495	0.5542	0.5591 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073		(30)
Total net area of external elements Aum(A, m ²)			324.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.7915	(33)

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

450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560
R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689

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Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0345 (36)
 Point Thermal bridges 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 82.8260 (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	65.1764	64.8672	64.5642	63.1409	62.8746	61.6350	61.6350	61.4055	62.1125	62.8746	63.4133	63.9765 (38)
Average = Sum(39)m / 12 =	148.0023	147.6932	147.3902	145.9669	145.7006	144.4610	144.4610	144.2315	144.9385	145.7006	146.2393	146.8025 (39)
												145.9657

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0306	1.0284	1.0263	1.0164	1.0146	1.0059	1.0059	1.0043	1.0093	1.0146	1.0183	1.0222 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hot water usage for baths	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338 (42b)
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171 (42c)
Average daily hot water use (litres/day)												125.1081 (43)
Daily hot water use	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509 (44)
Energy conte	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399 (45)
Energy content (annual)												Total = Sum(45)m = 2077.6008
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440 (61)
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (62)
WWHS	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)
FGHS	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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Electric shower(s)												
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558 (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	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Water heating gains (Table 5)	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836 (72)
Total internal gains	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	10.9900	11.2829	0.5700	0.7000	0.7700	34.2867 (75)
Southwest	7.3400	36.7938	0.5700	0.7000	0.7700	74.6753 (79)
Northwest	2.6600	11.2829	0.5700	0.7000	0.7700	8.2987 (81)

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Northeast		0.4700	18.0708	0.5700	0.7000	1.0000	3.0499 (82)					
Solar gains	120.3107	220.2909	342.2037	492.3813	613.9176	636.9301	602.6443	507.7758	393.5484	254.4669	146.9012	101.1512 (83)
Total gains	895.8592	989.1820	1080.7921	1180.5601	1251.8030	1229.1774	1172.4775	1085.1282	1000.4062	911.7728	858.0419	856.9718 (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	121.2903	121.5442	121.7941	122.9816	123.2064	124.2636	124.2636	124.4614	123.8543	123.2064	122.7525	122.2816
alpha	9.0860	9.1029	9.1196	9.1988	9.2138	9.2842	9.2842	9.2974	9.2570	9.2138	9.1835	9.1521
util living area	0.9999	0.9998	0.9990	0.9917	0.9338	0.7382	0.5413	0.6089	0.9024	0.9963	0.9998	1.0000 (86)
MIT	20.2697	20.3562	20.5097	20.7236	20.9136	20.9920	20.9995	20.9988	20.9548	20.7182	20.4548	20.2535 (87)
Th 2	20.0579	20.0597	20.0615	20.0697	20.0712	20.0784	20.0784	20.0797	20.0756	20.0712	20.0681	20.0648 (88)
util rest of house	0.9999	0.9997	0.9983	0.9853	0.8900	0.6400	0.4285	0.4888	0.8261	0.9924	0.9996	0.9999 (89)
MIT 2	19.2037	19.3161	19.5142	19.7914	20.0083	20.0755	20.0783	20.0795	20.0520	19.7882	19.4495	19.1886 (90)
Living area fraction									fLA = Living area / (4) =			0.4218 (91)
MIT	19.6533	19.7548	19.9341	20.1846	20.3901	20.4621	20.4669	20.4672	20.4328	20.1804	19.8735	19.6377 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5033	19.6048	19.7841	20.0346	20.2401	20.3121	20.3169	20.3172	20.2828	20.0304	19.7235	19.4877 (93)

8. Space heating requirement												

Utilisation	0.9999	0.9996	0.9980	0.9850	0.8994	0.6658	0.4578	0.5201	0.8460	0.9922	0.9995	0.9999 (94)
Useful gains	895.7340	988.7628	1078.6408	1162.8149	1125.8214	818.3530	536.7359	564.3589	846.2947	904.6546	857.6378	856.8928 (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	2250.1256	2171.7961	1957.9403	1625.2801	1244.3023	825.1728	536.9425	564.9868	896.1196	1374.0224	1846.0543	2244.2777 (97)
Space heating kWh	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98a)
Space heating requirement - total per year (kWh/year)												4971.0732
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	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4971.0732
Space heating per m2										(98c) / (4) =		34.6151 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												84.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1007.6674	794.9984	654.1988	332.9750	88.1498	0.0000	0.0000	0.0000	0.0000	349.2096	711.6599	1032.2144 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1079.6436	851.7840	700.9273	356.7589	94.4462	0.0000	0.0000	0.0000	0.0000	374.1532	762.4927	1105.9440 (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)	155.0258	122.3074	100.6460	51.2269	13.5615	0.0000	0.0000	0.0000	0.0000	53.7246	109.4861	158.8022 (215)
Water heating												
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Efficiency of water heater	88.6170	88.5825	88.4977	88.2877	87.7682	87.3000	87.3000	87.3000	87.3000	88.3032	88.5463	87.3000 (216)
Fuel for water heating, kWh/month	291.9383	257.9112	273.6519	240.0888	233.2926	210.4807	207.2592	216.0728	219.0586	242.4863	258.2909	288.6059 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-73.1218	-99.7230	-138.3470	-149.2853	-155.2263	-142.6451	-141.1696	-136.6032	-126.8012	-111.8228	-79.3371	-63.6268 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												

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(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-52.0945	-109.2269	-217.5186	-327.6448	-433.9807	-436.6392	-430.4593	-362.8318	-264.3566	-155.2919	-69.1874	-41.1578	(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													5326.1499 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													764.7805 (215)
Efficiency of water heater													87.3000
Water heating fuel used													2939.1371 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													86.0000 (231)
Electricity for lighting (calculated in Appendix L)													564.7001 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4318.0985 (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													5362.6691 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5326.1499	3.6400	193.8719 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	764.7805	5.1200	39.1568 (242)
Water heating (other fuel)	2939.1371	3.6400	106.9846 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814 (249)
Energy for lighting	564.7001	16.4900	93.1190 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	16.4900	-233.7802
PV Unit electricity exported	-2900.3893	5.5900	-162.1318
Total			-395.9120 (252)
Total energy cost			143.4017 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2737 (257)
SAP value		95.5631
SAP rating (Section 12)		96 (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	5326.1499	0.2100	1118.4915 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	764.7805	0.0280	21.4139 (263)
Water heating (other fuel)	2939.1371	0.2100	617.2188 (264)
Space and water heating			1757.1241 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1417.7091	0.1354	-191.9948
PV Unit electricity exported	-2900.3893	0.1259	-365.0822
Total			-557.0770 (269)
Total CO2, kg/year			1293.4801 (272)
CO2 emissions per m2			9.0100 (273)
EI value			90.8103
EI rating			91 (274)
EI band			B

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	73.7700 (1b)	x 2.4000 (2b)	= 177.0480 (1b) -
First floor	69.8400 (1c)	x 2.4300 (2c)	= 169.7112 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	143.6100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.7592 (5)

2. Ventilation rate

		m ³ per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	1 * 20 =	20.0000 (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	3 * 10 =	30.0000 (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) =	50.0000 / (5) =	0.1442 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.3442	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2926 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.5000	4.5000	4.1000	4.0000	3.5000	3.6000	3.7000	3.8000	3.9000	4.0000	4.2000 (22)
Wind factor	1.1750	1.1250	1.1250	1.0250	1.0000	0.8750	0.9000	0.9250	0.9500	0.9750	1.0000	1.0500 (22a)
Adj infilt rate	0.3438	0.3291	0.3291	0.2999	0.2926	0.2560	0.2633	0.2706	0.2779	0.2852	0.2926	0.3072 (22b)
Effective ac	0.5591	0.5542	0.5542	0.5450	0.5428	0.5328	0.5347	0.5366	0.5386	0.5407	0.5428	0.5472 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Windows (Uw = 0.80)			20.9900	0.7752	16.2713		(27)
Door			3.6400	1.0000	3.6400		(26)
Front Rooflight			0.4700	0.7752	0.3643		(27a)
Heatloss Floor 1			73.7700	0.1300	9.5901		(28a)
External Wall 1	156.2000	24.6300	131.5700	0.1600	21.0512		(29a)
External Wall 2	12.4000		12.4000	0.1500	1.8600		(29a)
Loft	45.5200		45.5200	0.1100	5.0072		(30)
Rafter	36.9000	0.4700	36.4300	0.1100	4.0073		(30)
Total net area of external elements Aum(A, m ²)			324.7900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.7915		(33)

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

450.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2000	0.0560	0.9632
E3 Sill	15.4400	0.0220	0.3397
E4 Jamb	43.0800	0.0190	0.8185
E10 Eaves (insulation at ceiling level)	19.5600	0.0570	1.1149
E11 Eaves (insulation at rafter level)	10.2800	0.0600	0.6168
E12 Gable (insulation at ceiling level)	14.6200	0.1700	2.4854
E13 Gable (insulation at rafter level)	15.8700	0.0860	1.3648
E16 Corner (normal)	34.6700	0.0450	1.5601
E17 Corner (inverted - internal area greater than external area)	9.6000	-0.0670	-0.6432
R1 Head of roof window	0.6000	0.0610	0.0366
R2 Sill of roof window	0.6000	0.0600	0.0360
R3 Jamb of roof window	1.5600	0.0560	0.0874
R5 Ridge (inverted)	6.3000	0.1200	0.7560

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R6 Flat ceiling	17.2400	0.1200	2.0688
R8 Roof to wall (rafter)	17.8000	0.1200	2.1360
E5 Ground floor (normal)	36.8600	0.1960	7.2246
E6 Intermediate floor within a dwelling	34.4600	0.0020	0.0689
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			21.0345 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			82.8260 (37) (33) + (36) + (36a) =

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	63.9765	63.4133	63.4133	62.3604	62.1125	60.9647	61.1820	61.4055	61.6350	61.8707	62.1125	62.6145 (38)
Average = Sum(39)m / 12 =	146.8025	146.2393	146.2393	145.1864	144.9385	143.7907	144.0080	144.2315	144.4610	144.6967	144.9385	145.4405 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0222	1.0183	1.0183	1.0110	1.0093	1.0013	1.0028	1.0043	1.0059	1.0076	1.0093	1.0127 (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													2.9237 (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	88.9344	87.6136	85.7536	82.3242	79.7563	76.9089	75.3708	77.2178	79.2288	82.2756	85.7757	88.6338	88.6338 (42b)
Hot water usage for other uses	46.9171	45.2110	43.5049	41.7989	40.0928	38.3867	38.3867	40.0928	41.7989	43.5049	45.2110	46.9171	46.9171 (42c)
Average daily hot water use (litres/day)													125.1081 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	135.8515	132.8246	129.2586	124.1231	119.8491	115.2956	113.7575	117.3106	121.0276	125.7806	130.9867	135.5509	135.5509 (44)
Energy content (annual)	215.1556	189.1405	198.6656	169.9183	161.3399	141.7694	137.5799	145.2550	149.2392	170.6830	186.6146	212.2399	212.2399 (45)
Distribution loss (46)m = 0.15 x (45)m	32.2733	28.3711	29.7998	25.4877	24.2010	21.2654	20.6370	21.7882	22.3859	25.6025	27.9922	31.8360	31.8360 (46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	43.5513	39.3237	43.5101	42.0507	43.4168	41.9803	43.3574	43.3766	41.9990	43.4401	42.0924	43.5440	43.5440 (61)
Total heat required for water heating calculated for each month	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	255.7839 (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	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839	255.7839 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	82.4271	72.7201	76.9339	67.0105	64.4997	57.6334	56.5847	59.1414	60.1218	67.6121	72.5725	81.4558	81.4558 (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	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198	175.4198 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.9391	71.0012	57.7421	43.7145	32.6771	27.5874	29.8091	38.7470	52.0062	66.0338	77.0712	82.1609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	467.8813	472.7365	460.5017	434.4552	401.5762	370.6746	350.0305	345.1753	357.4101	383.4566	416.3356	447.2372 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656	55.4656 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466	-116.9466 (71)
Water heating gains (Table 5)	110.7891	108.2145	103.4057	93.0701	86.6932	80.0464	76.0546	79.4912	83.5025	90.8765	100.7951	109.4836 (72)
Total internal gains	775.5485	768.8911	738.5884	688.1788	637.8854	592.2473	569.8332	577.3525	606.8577	657.3058	711.1407	755.8205 (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	

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Northeast	10.9900	12.9513	0.5700	0.7000	0.7700	39.3566 (75)
Southwest	7.3400	41.0864	0.5700	0.7000	0.7700	83.3874 (79)
Northwest	2.6600	12.9513	0.5700	0.7000	0.7700	9.5258 (81)
Northeast	0.4700	20.8536	0.5700	0.7000	1.0000	3.5196 (82)

Solar gains	135.7894	232.2401	352.0982	522.2796	635.2257	687.5967	643.4966	544.5646	423.7399	280.6638	165.6103	112.9920 (83)
Total gains	911.3379	1001.1312	1090.6866	1210.4583	1273.1111	1279.8440	1213.3297	1121.9171	1030.5976	937.9697	876.7511	868.8126 (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	122.2816	122.7525	122.7525	123.6428	123.8543	124.8429	124.6545	124.4614	124.2636	124.0612	123.8543	123.4268
alpha	9.1521	9.1835	9.1835	9.2429	9.2570	9.3229	9.3103	9.2974	9.2842	9.2707	9.2570	9.2285
util living area	0.9999	0.9998	0.9986	0.9862	0.8981	0.6260	0.4153	0.4498	0.8088	0.9920	0.9997	0.9999 (86)
MIT	20.2991	20.3854	20.5486	20.7722	20.9454	20.9981	21.0000	20.9999	20.9846	20.7802	20.4915	20.2823 (87)
Th 2	20.0648	20.0681	20.0681	20.0742	20.0756	20.0823	20.0810	20.0797	20.0784	20.0770	20.0756	20.0727 (88)
util rest of house	0.9999	0.9996	0.9976	0.9758	0.8392	0.5254	0.3063	0.3316	0.7028	0.9835	0.9994	0.9999 (89)
MIT 2	19.2471	19.3605	19.5693	19.8545	20.0407	20.0818	20.0810	20.0797	20.0729	19.8698	19.5028	19.2321 (90)
Living area fraction										fLA = Living area / (4) =		0.4218 (91)
MIT	19.6908	19.7928	19.9823	20.2416	20.4223	20.4683	20.4686	20.4678	20.4574	20.2538	19.9198	19.6750 (92)
Temperature adjustment												-0.1500
adjusted MIT	19.5408	19.6428	19.8323	20.0916	20.2723	20.3183	20.3186	20.3178	20.3074	20.1038	19.7698	19.5250 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9998	0.9995	0.9973	0.9760	0.8534	0.5516	0.3345	0.3622	0.7311	0.9839	0.9993	0.9999 (94)
Useful gains	911.1753	1000.6072	1087.7306	1181.4332	1086.4141	705.9461	405.8910	406.3997	753.4800	922.8350	876.1544	868.7132 (95)
Ext temp.	4.5000	5.1000	6.9000	9.4000	12.3000	15.4000	17.5000	17.5000	15.0000	11.3000	7.4000	4.4000 (96)
Heat loss rate W	2208.0312	2126.7278	1891.2162	1552.2715	1155.4867	707.2037	405.9011	406.4203	766.7104	1273.8793	1792.8592	2199.7941 (97)
Space heating kWh	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242 (98a)
Space heating requirement - total per year (kWh/year)												4549.3294
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	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4549.3294
Space heating per m2												(98c) / (4) = 31.6784 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.1000 (201)

Fraction of space heat from main system(s) 0.9000 (202)

Efficiency of main space heating system 1 (in %) 84.0000 (206)

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

Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	964.8608	756.7530	597.7933	267.0036	51.3900	0.0000	0.0000	0.0000	0.0000	261.1770	660.0275	990.3242 (98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)	1033.7795	810.8068	640.4928	286.0753	55.0608	0.0000	0.0000	0.0000	0.0000	279.8325	707.1723	1061.0617 (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)	148.4401	116.4235	91.9682	41.0775	7.9062	0.0000	0.0000	0.0000	0.0000	40.1811	101.5427	152.3576 (215)
Water heating												
Water heating requirement	258.7069	228.4642	242.1757	211.9690	204.7567	183.7497	180.9373	188.6316	191.2382	214.1232	228.7070	255.7839 (64)
Efficiency of water heater (217)m	88.6040	88.5668	88.4653	88.1951	87.6083	87.3000	87.3000	87.3000	87.3000	88.1814	88.5208	87.3000 (216)
Fuel for water heating, kWh/month	291.9812	257.9570	273.7523	240.3410	233.7182	210.4807	207.2592	216.0728	219.0586	242.8211	258.3652	288.6456 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	69.9703	56.1327	50.5413	37.0287	28.6021	23.3681	26.0918	33.9150	44.0523	57.7990	65.2838	71.9149 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-79.8732	-103.0430	-140.1747	-152.4889	-156.5827	-145.3872	-143.4839	-139.4806	-130.5122	-117.8838	-86.0664	-69.1794 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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	-61.7738	-117.3004	-224.8936	-350.5540	-449.2039	-476.0874	-463.0408	-392.8682	-288.8733	-176.4572	-81.6658	-48.1928	(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												4874.2815	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												699.8968	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2940.4531	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												564.7001	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4595.0671	(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												4570.2644	(238)

10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4874.2815	3.5000	170.5999 (240)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	699.8968	6.3000	44.0935 (242)
Water heating (other fuel)	2940.4531	3.5000	102.9159 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	86.0000	18.3900	15.8154 (249)
Energy for lighting	564.7001	18.3900	103.8483 (250)
Additional standing charges			94.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	18.3900	-269.2583
PV Unit electricity exported	-3130.9110	5.8100	-181.9059
Total			-451.1642 (252)
Total energy cost			80.1087 (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	4874.2815	0.2100	1023.5991 (261)
Total CO2 associated with community systems			0.0000 (373)
Space heating - secondary	699.8968	0.0280	19.5971 (263)
Water heating (other fuel)	2940.4531	0.2100	617.4952 (264)
Space and water heating			1660.6914 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	564.7001	0.1443	81.5037 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	0.1357	-198.6497
PV Unit electricity exported	-3130.9110	0.1260	-394.3576
Total			-593.0073 (269)
Total CO2, kg/year			1161.1170 (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	4874.2815	1.1300	5507.9381 (275)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	699.8968	1.0460	732.0921 (277)
Water heating (other fuel)	2940.4531	1.1300	3322.7120 (278)
Space and water heating			9562.7422 (279)

Full SAP Calculation Printout



Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	564.7001	1.5338	866.1558 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1464.1561	1.5015	-2198.4108
PV Unit electricity exported	-3130.9110	0.4623	-1447.4681
Total			-3645.8790 (283)
Total Primary energy kWh/year			6913.1198 (286)