

# Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Thu 30 Nov 2023 13:30:40

Project Information			
Assessed By	Warren Mazgaj	Building Type	House, Detached
OCDEA Registration	EES/006550	Assessment Date	2023-11-30

Dwelling Details			
Assessment Type	As designed	Total Floor Area	243 m <sup>2</sup>
Site Reference	23-S936	Plot Reference	23-S936
Address	New Dwelling Land East of Lower Town Barn, Trewidland, PL14 4ST		

Client Details	
Name	MAH Building Serviced Ltd
Company	MAH Building Serviced Ltd
Address	-, -, -

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	6.79 kgCO <sub>2</sub> /m <sup>2</sup>		
Dwelling carbon dioxide emission rate	1.36 kgCO <sub>2</sub> /m <sup>2</sup>	OK	
1b Target primary energy rate and dwelling primary energy			
Target primary energy	35.78 kWh <sub>PE</sub> /m <sup>2</sup>		
Dwelling primary energy	13.43 kWh <sub>PE</sub> /m <sup>2</sup>	OK	
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	35.8 kWh/m <sup>2</sup>		
Dwelling fabric energy efficiency	30.9 kWh/m <sup>2</sup>	OK	

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.17	Walls (1) (0.17)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.09	Floor (0.09)	OK
Roofs	0.16	0.08	Roof (1) (0.08)	OK
Windows, doors, and roof windows	1.6	1.21	NW Door (1.4)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	134.066	0.17
Ground floor: Floor, Floor	121.4	0.09 (!)
Exposed roof: Roof (1)	159.94	0.08 (!)

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
NW Door, Door	2.4	North West	N/A	1.4
NW Windows, Window	0.72	North West	0.7	1.2
NW Windows, Window	0.72	North West	0.7	1.2
NW Windows, Window	1.44	North West	0.7	1.2
NW Rooflight, Rooflight	0.72	North West	0.7	1.2
NW Rooflight, Rooflight	0.72	North West	0.7	1.2
NW Rooflight, Rooflight	0.72	North West	0.7	1.2
NW Rooflight, Rooflight	0.72	North West	0.7	1.2
NW Rooflight, Rooflight	0.72	North West	0.7	1.2
SE Windows, Window	7.2	South East	0.7	1.2
SE Windows, Window	9.6	South East	0.7	1.2
SE Windows, Window	10.152	South East	0.7	1.2
SE Windows, Window	3.36	South East	0.7	1.2
SE Rooflight, Rooflight	0.72	South East	0.7	1.2

Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
SE Rooflight, Rooflight	0.72	South East	0.7	1.2
SE Rooflight, Rooflight	1.92	South East	0.7	1.2
SE Rooflight, Rooflight	1.92	South East	0.7	1.2
SE Rooflight, Rooflight	1.92	South East	0.7	1.2
SE Rooflight, Rooflight	1.92	South East	0.7	1.2
NE Window, Window	6.072	North East	0.7	1.2

### 2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part 1 - **Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.58	UI-CWP-E2-WDC-03 V1
External wall	E3: Sill	Not government-approved scheme	0.016 (!)	UI-CWP-E3-WD C-CON-04
External wall	E4: Jamb	Not government-approved scheme	0.001 (!)	UI-CWP-E4-WD-06 V1
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.052	UI-CWP-E5-GF-01 V1
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 (!)	UI-CWP-E6-IF-02 V1
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 (!)	UI-CWP-E16-EXT-CRN V1
Roof	R1: Head of roof window	Not government-approved scheme	0.061	UI-GEN-R1-Head-01 V1
Roof	R2: Sill of roof window	Not government-approved scheme	0.06	UI-GEN-R2-Sill-01 V1
Roof	R3: Jamb of roof window	Not government-approved scheme	0.056	UI-GEN-R3-Jamb-01 V1
External wall	E11: Eaves (insulation at rafter level)	Not government-approved scheme	0.048	UI-CWP-E11-RF-03 V1
External wall	E13: Gable (insulation at rafter level)	Not government-approved scheme	0.037 (!)	UI-CWP-E13-RG-03 V1
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	

### 3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m <sup>3</sup> /hm <sup>2</sup>	
Dwelling air permeability at 50Pa	3.2 m <sup>3</sup> /hm <sup>2</sup> , Design value (!)	OK
Air permeability test certificate reference		

### 4 Space heating

**Main heating system 1:** Heat pump with radiators or underfloor heating - Electricity

Efficiency	249.9%
Emitter type	Both radiators and underfloor
Flow temperature	35°C
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
<b>Secondary heating system:</b> N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

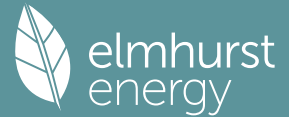
### 5 Hot water

**Cylinder/store** - type: Cylinder

Capacity	210 litres
Declared heat loss	1.75 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

<b>Waste water heat recovery system 1</b> - type: N/A		
Efficiency		
Manufacturer		
Model		
<b>6 Controls</b>		
<b>Main heating 1</b> - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
<b>Water heating</b> - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		
<b>7 Lighting</b>		
<i>Minimum permitted light source efficacy</i>	75 lm/W	
Lowest light source efficacy	99 lm/W	OK
External lights control	N/A	
<b>8 Mechanical ventilation</b>		
<b>System type:</b> Balanced whole-house mechanical ventilation with heat recovery		
<i>Maximum permitted specific fan power</i>	1.5 W/(l/s)	
Specific fan power	0.56 W/(l/s)	OK
<i>Minimum permitted heat recovery efficiency</i>	73%	
Heat recovery efficiency	87%	OK
Manufacturer/Model	WHHR-Maxi Plus BY	
Commissioning		
<b>9 Local generation</b>		
Technology type: <b>Photovoltaic system (1)</b>		
Peak power	4 kWp	
Orientation	South West	
Pitch	30°	
Overshading	1 (overshading factor calculated according to MCS)	
Manufacturer		
MCS certificate		
<b>10 Heat networks</b>		
N/A		
<b>11 Supporting documentary evidence</b>		
N/A		
<b>12 Declarations</b>		
<b>a. Assessor Declaration</b>		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
<b>b. Client Declaration</b>		
N/A		

# Full SAP Calculation Printout



Property Reference	23-S936		Issued on Date	30/11/2023	
Assessment Reference	23-S936	Prop Type Ref			
Property	New Dwelling, Land East of Lower Town Barn, Trewidland, Cornwall, PL14 4ST				
SAP Rating	93 A	DER	1.36	TER	6.79
Environmental	99 A	% DER < TER	79.97		
CO <sub>2</sub> Emissions (t/year)	0.24	DFEE	30.88	TFEE	35.81
Compliance Check	See BREL	% DFEE < TFEE	13.77		
% DPER < TPER	62.48	DPER	13.43	TPER	35.78
Assessor Details	Mr. Warren Mazgaj			Assessor ID	B581-0001
Client	HORSLEY01, MAH Building Serviced Ltd				

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	594.8600 (5)

## 2. Ventilation rate

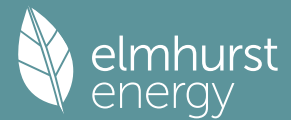
	m3 per hour												
Number of open chimneys	0 * 80 =											0.0000 (6a)	
Number of open flues	0 * 20 =											0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)	
Number of blocked chimneys	0 * 20 =											0.0000 (6f)	
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =											0.0000 (8)	
Pressure test	Yes												
Pressure Test Method	Blower Door												
Measured/design AP50	3.2000											(17)	
Infiltration rate	0.1600											(18)	
Number of sides sheltered	1											(19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =											0.9250 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.1480 (21)	
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1887	0.1850	0.1813	0.1628	0.1591	0.1406	0.1406	0.1369	0.1480	0.1591	0.1665	0.1739	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000 (23a)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												78.3000 (23c)	
Effective ac	0.2972	0.2935	0.2898	0.2713	0.2676	0.2491	0.2491	0.2454	0.2565	0.2676	0.2750	0.2824	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K	
Window (Uw = 1.20)			39.2600	1.1450	44.9542		(27)	
Door			2.4000	1.4000	3.3600		(26a)	
NW Rooflight			3.6000	1.1450	4.1221		(27a)	
SE Rooflight			9.1200	1.1450	10.4427		(27a)	
Floor			121.4000	0.0900	10.9260		(28a)	
Wall	175.7300	41.6600	134.0700	0.1700	22.7919		(29a)	
Roof	172.6600	12.7200	159.9400	0.0800	12.7952		(30)	
Total net area of external elements Aum(A, m <sup>2</sup> )			469.7900				(31)	
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.3922	(33)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								250.0000 (35)
List of Thermal Bridges								
K1 Element				Length	Psi-value	Total		
E2 Other lintels (including other steel lintels)				19.9600	0.5800	11.5768		

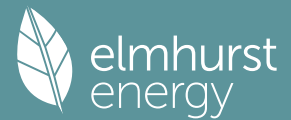


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Northwest	3.6000	16.3666	0.7200	0.7000	1.0000	26.7260 (82)						
Solar gains	616.8822	1094.2754	1602.4046	2144.8028	2535.5445	2572.5201	2457.4070	2159.6051	1790.3905	1238.7651	747.0551	522.4984 (83)
Total gains	1491.2223	1991.8268	2460.7356	2973.0827	3319.5149	3324.2911	3178.5577	2881.0034	2534.7047	2012.0100	1569.5314	1376.9221 (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	88.8512	89.1926	89.5366	91.2972	91.6577	93.5036	93.5036	93.8818	92.7564	91.6577	90.9396	90.2326
alpha	6.9234	6.9462	6.9691	7.0865	7.1105	7.2336	7.2336	7.2588	7.1838	7.1105	7.0626	7.0155
util living area	0.9971	0.9812	0.9151	0.7242	0.5131	0.3471	0.2496	0.2867	0.4932	0.8535	0.9880	0.9983 (86)
MIT	20.3580	20.5684	20.7852	20.9271	20.9536	20.9569	20.9570	20.9571	20.9553	20.8864	20.5903	20.3278 (87)
Th 2	20.2693	20.2719	20.2745	20.2876	20.2902	20.3033	20.3033	20.3059	20.2980	20.2902	20.2850	20.2797 (88)
util rest of house	0.9962	0.9760	0.8963	0.6884	0.4748	0.3093	0.2101	0.2435	0.4438	0.8177	0.9839	0.9977 (89)
MIT 2	19.5081	19.7761	20.0402	20.2055	20.2321	20.2480	20.2481	20.2509	20.2416	20.1712	19.8169	19.4783 (90)
Living area fraction	19.6166	19.8773	20.1353	20.2976	20.3242	20.3385	20.3386	20.3411	20.3327	20.2625	19.9157	19.5868 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6166	19.8773	20.1353	20.2976	20.3242	20.3385	20.3386	20.3411	20.3327	20.2625	19.9157	19.5868 (93)
-----												
8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9952	0.9726	0.8923	0.6889	0.4766	0.3112	0.2121	0.2457	0.4462	0.8162	0.9812	0.9970 (94)
Useful gains	1484.0356	1937.1588	2195.7691	2048.2831	1582.1345	1034.6522	674.1600	707.7942	1131.0497	1642.1107	1540.0083	1372.8131 (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	2906.5999	2831.3273	2567.7420	2104.9545	1586.4933	1034.8058	674.1672	707.8143	1132.9788	1777.4895	2376.1561	2875.2140 (97)
Space heating kWh	1058.3878	600.8812	276.7478	40.8034	3.2430	0.0000	0.0000	0.0000	0.0000	100.7218	602.0264	1117.7863 (98a)
Space heating requirement - total per year (kWh/year)												3800.5979
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	1058.3878	600.8812	276.7478	40.8034	3.2430	0.0000	0.0000	0.0000	0.0000	100.7218	602.0264	1117.7863 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3800.5979
Space heating per m2												(98c) / (4) = 15.6532 (99)
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9a. Energy requirements - Individual heating systems, including micro-CHP												
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												249.9000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1058.3878	600.8812	276.7478	40.8034	3.2430	0.0000	0.0000	0.0000	0.0000	100.7218	602.0264	1117.7863 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	423.5245	240.4487	110.7434	16.3279	1.2977	0.0000	0.0000	0.0000	0.0000	40.3048	240.9069	447.2934 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	341.3064	301.8021	319.9579	279.0712	269.1368	240.9485	236.3789	246.4551	249.9774	280.6746	300.8946	337.2300 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	194.9209	172.3598	182.7286	159.3782	153.7046	137.6062	134.9965	140.7511	142.7626	160.2939	171.8416	192.5928 (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	48.3236	43.6471	48.3236	46.7648	48.3236	46.7648	48.3236	48.3236	46.7648	48.3236	46.7648	48.3236 (231)
Lighting	42.1709	33.8311	30.4611	22.3171	17.2384	14.0839	15.7254	20.4405	26.5502	34.8353	39.3464	43.3430 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-82.2320	-132.4131	-212.9697	-260.3062	-296.9330	-282.7023	-278.7353	-255.4802	-213.6754	-159.9451	-95.5105	-68.9494 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1520.8475 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1943.9369 (219)
Space cooling fuel												0.0000 (221)

# Full SAP Calculation Printout



Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7840) mechanical ventilation fans (SFP = 0.7840)		568.9717 (230a)
Total electricity for the above, kWh/year		568.9717 (231)
Electricity for lighting (calculated in Appendix L)		340.3433 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-2339.8521 (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		2034.2472 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1 (high-rate cost)	912.5085	0.1640	149.6623 (261)
Space heating - main system 1 (low-rate cost)	608.3390	0.1514	92.1059 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	1360.7558	0.1458	198.3793 (264)
Water heating - low rate cost	583.1811	0.1345	78.4550 (264)
Space and water heating			518.6024 (265)
Pumps, fans and electric keep-hot	568.9717	0.1412	78.9304 (267)
Energy for lighting	340.3433	0.1468	49.9765 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2339.8521	0.1351	-316.1708
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-316.1708 (269)
Total CO2, kg/year			331.3385 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.3600 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1 (high-rate cost)	912.5085	0.9663	1469.5966 (275)
Space heating - main system 1 (low-rate cost)	608.3390	1.5570	947.1813 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating - high rate cost	1360.7558	1.5430	2099.6712 (278)
Water heating - low rate cost	583.1811	1.4917	869.9087 (278)
Space and water heating			5386.3578 (279)
Pumps, fans and electric keep-hot	568.9717	1.5239	860.6712 (281)
Energy for lighting	340.3433	1.5451	525.8552 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2339.8521	1.5014	-3513.0485
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-3513.0485 (283)
Total Primary energy kWh/year			3259.8356 (286)
Dwelling Primary energy Rate (DPER)			13.4300 (287)

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

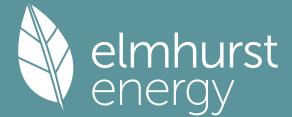
### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 594.8600 (5)

### 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0672 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3172 (18)
Number of sides sheltered	1 (19)

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Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2934 (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												
Effective ac	0.3741	0.3668	0.3595	0.3228	0.3155	0.2788	0.2788	0.2714	0.2934	0.3155	0.3301	0.3448 (22b)
	0.5700	0.5673	0.5646	0.5521	0.5498	0.5389	0.5389	0.5368	0.5431	0.5498	0.5545	0.5594 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Semi-glazed door			2.4000	1.0000	2.4000		(26a)
TER Opening Type (Uw = 1.20)			39.2600	1.1450	44.9542		(27)
NW Rooflight			3.6000	1.4151	5.0943		(27a)
SE Rooflight			9.1200	1.4151	12.9057		(27a)
Floor			121.4000	0.1300	15.7820		(28a)
Wall	175.7300	41.6600	134.0700	0.1800	24.1326		(29a)
Roof	172.6600	12.7200	159.9400	0.1100	17.5934		(30)
Total net area of external elements Aum(A, m2)			469.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 122.8622		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.9600	0.0500	0.9980
E3 Sill	5.2000	0.0500	0.2600
E4 Jamb	31.2000	0.0500	1.5600
E5 Ground floor (normal)	49.1000	0.1600	7.8560
E6 Intermediate floor within a dwelling	49.1000	0.0000	0.0000
E16 Corner (normal)	12.4000	0.0900	1.1160
R1 Head of roof window	7.4000	0.0800	0.5920
R2 Sill of roof window	4.2000	0.0600	0.2520
R3 Jamb of roof window	36.0000	0.0800	2.8800
E11 Eaves (insulation at rafter level)	35.6000	0.0400	1.4240
E13 Gable (insulation at rafter level)	19.4000	0.0800	1.5520
R4 Ridge (vaulted ceiling)	17.8000	0.0800	1.4240

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.9140 (36)

#### Point Thermal Bridges

Total fabric heat loss (33) + (36) + (36a) = 142.7762 (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	111.8919	111.3583	110.8354	108.3790	107.9194	105.7799	105.7799	105.3837	106.6040	107.9194	108.8491	109.8211 (38)
Average = Sum(39)m / 12 =	254.6681	254.1345	253.6116	251.1552	250.6956	248.5561	248.5561	248.1599	249.3802	250.6956	251.6253	252.5973 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0489	1.0467	1.0445	1.0344	1.0325	1.0237	1.0237	1.0221	1.0271	1.0325	1.0363	1.0404 (40)
Days in month	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	75.4853	74.3509	72.6978	69.5350	67.2010	64.5981	63.1186	64.7591	66.5574	69.3522	72.5829	75.1961 (42a)
Hot water usage for baths	32.5844	32.1004	31.4190	30.1625	29.2216	28.1784	27.6148	28.2915	29.0283	30.1447	31.4270	32.4742 (42b)
Hot water usage for other uses	45.9426	44.2719	42.6013	40.9307	39.2600	37.5894	37.5894	39.2600	40.9307	42.6013	44.2719	45.9426 (42c)
Average daily hot water use (litres/day)												141.5717 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	154.0122	150.7232	146.7181	140.6282	135.6826	130.3658	128.3228	132.3107	136.5164	142.0981	148.2819	153.6128 (44)
Distribution loss (46)m = 0.15 x (45)m	243.9177	214.6279	225.5003	192.5129	182.6549	160.3000	155.1953	163.8282	168.3384	192.8258	211.2547	240.5206 (45)
Total = Sum(45)m =	36.5877	32.1942	33.8250	28.8769	27.3982	24.0450	23.2793	24.5742	25.2508	28.9239	31.6882	36.0781 (46)

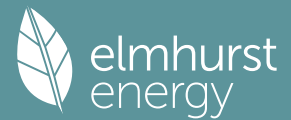
Water storage loss:  
 Store volume 210.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 1.7016 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 0.9188 (55)

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842 (56)
28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842 (57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
295.6643	261.3668	277.2469	242.5903	234.4015	210.3773	206.9419	215.5748	218.4157	244.5724	261.3320	292.2672	292.2672 (62)
-34.5087	-30.5198	-31.9586	-26.4630	-24.6625	-21.1039	-19.7815	-21.0357	-21.8349	-25.7409	-29.1614	-33.8697	-33.8697 (63a)
-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)
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)
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)
261.1556	230.8470	245.2883	216.1273	209.7390	189.2734	187.1603	194.5391	196.5808	218.8315	232.1707	258.3975	258.3975 (64)
Total per year (kWh/year) = Sum(64)m = 2640.1105 (64a)												
Electric shower(s) 2640 (64)												
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) = Sum(64a)m = 0.0000 (64a)												

Heat gains from water heating, kWh/month  
 122.4999 108.7549 116.3761 104.0724 102.1300 93.3616 92.9997 95.8702 96.0344 105.5119 110.3041 121.3704 (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	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	206.8203	228.9797	206.8203	213.7144	206.8203	213.7144	206.8203	206.8203	213.7144	206.8203	213.7144	206.8203 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.0985	414.3540	403.6302	380.8004	351.9820	324.8967	306.8021	302.5465	313.2704	336.1001	364.9185	392.0038 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878 (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)	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028 (71)
Water heating gains (Table 5)	164.6504	161.8376	156.4195	144.5450	137.2715	129.6689	124.9996	128.8577	133.3811	141.8170	153.2001	163.1322 (72)
Total internal gains	853.4328	877.0348	838.7336	810.9234	767.9374	737.1435	707.4856	707.0882	729.2294	756.6010	803.6965	833.8199 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	FF	Access Factor Table 6d	Gains W					
Northeast	6.0700	11.2829	0.6300	0.7000	0.7700	20.9307 (75)						
Southeast	30.3100	36.7938	0.6300	0.7000	0.7700	340.8261 (77)						
Northwest	2.8800	11.2829	0.6300	0.7000	0.7700	9.9309 (81)						
Southeast	9.1200	39.9751	0.6300	0.7000	1.0000	144.6991 (82)						
Northwest	3.6000	16.3666	0.6300	0.7000	1.0000	23.3852 (82)						
Solar gains	539.7719	957.4910	1402.1041	1876.7024	2218.6014	2250.9551	2150.2312	1889.6545	1566.5917	1083.9195	653.6732	457.1861 (83)
Total gains	1393.2047	1834.5258	2240.8376	2687.6258	2986.5388	2988.0986	2857.7167	2596.7426	2295.8211	1840.5205	1457.3698	1291.0060 (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	66.2082	66.3472	66.4840	67.1342	67.2573	67.8362	67.8362	67.9445	67.6121	67.2573	67.0088	66.7510
alpha	5.4139	5.4231	5.4323	5.4756	5.4838	5.5224	5.5224	5.5296	5.5075	5.4838	5.4673	5.4501
util living area	0.9984	0.9928	0.9724	0.8925	0.7256	0.5246	0.3815	0.4370	0.7042	0.9514	0.9951	0.9989 (86)
MIT	19.7127	19.9785	20.3255	20.7112	20.9258	20.9895	20.9985	20.9969	20.9530	20.6137	20.0770	19.6692 (87)
Th 2	20.0428	20.0446	20.0464	20.0548	20.0563	20.0636	20.0636	20.0650	20.0608	20.0563	20.0532	20.0498 (88)
util rest of house	0.9979	0.9905	0.9635	0.8626	0.6681	0.4513	0.3010	0.3496	0.6253	0.9308	0.9932	0.9986 (89)
MIT 2	18.5312	18.8715	19.3091	19.7751	19.9988	20.0581	20.0632	20.0639	20.0314	19.6757	19.0050	18.4807 (90)
Living area fraction	fLA = Living area / (4) =											0.1277 (91)
MIT	18.6821	19.0129	19.4389	19.8946	20.1171	20.1770	20.1826	20.1831	20.1490	19.7954	19.1418	18.6324 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6821	19.0129	19.4389	19.8946	20.1171	20.1770	20.1826	20.1831	20.1490	19.7954	19.1418	18.6324 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9967	0.9869	0.9563	0.8568	0.6721	0.4603	0.3113	0.3607	0.6332	0.9236	0.9904	0.9977 (94)
Useful gains	1388.5875	1810.5756	2142.9337	2302.7061	2007.1360	1375.4351	889.4925	936.6411	1453.7501	1699.9062	1443.4164	1288.0919 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.0000	14.0000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	3662.6576	3586.5682	3281.4487	2761.3473	2110.1324	1386.1963	890.4723	938.8038	1508.5083	2305.2531	3030.0278	3645.5930 (97)
Space heating kWh	1691.9081	1193.4670	847.0552	330.2216	76.6293	0.0000	0.0000	0.0000	0.0000	450.3781	1142.3602	1753.9808 (98a)
Space heating requirement - total per year (kWh/year)												7486.0004
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	1691.9081	1193.4670	847.0552	330.2216	76.6293	0.0000	0.0000	0.0000	0.0000	450.3781	1142.3602	1753.9808 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7486.0004
Space heating per m <sup>2</sup>												(98c) / (4) = 30.8320 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1691.9081	1193.4670	847.0552	330.2216	76.6293	0.0000	0.0000	0.0000	0.0000	450.3781	1142.3602	1753.9808 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	1833.0532	1293.0303	917.7196	357.7699	83.0220	0.0000	0.0000	0.0000	0.0000	487.9503	1237.6600	1900.3042 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating  
Water heating requirement

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Efficiency of water heater (217)m	261.1556	230.8470	245.2883	216.1273	209.7390	189.2734	187.1603	194.5391	196.5808	218.8315	232.1707	258.3975 (64)
Fuel for water heating, kWh/month	87.4807	87.2059	86.6066	85.0074	82.0246	79.8000	79.8000	79.8000	79.8000	85.6416	87.1400	79.8000 (216)
Space cooling fuel requirement (221)m	298.5293	264.7147	283.2211	254.2453	255.7026	237.1847	234.5368	243.7834	246.3419	255.5202	266.4341	295.2022 (219)
Pumps and Fa (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Lighting (234a)m	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)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	42.9732	34.4747	31.0406	22.7417	17.5663	14.3519	16.0246	20.8294	27.0553	35.4980	40.0949	44.1675 (232)
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	-98.4539	-131.7549	-179.7875	-191.4115	-197.5506	-181.0041	-178.3869	-172.3622	-160.9822	-144.9506	-105.5266	-85.9347 (233a)
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												8110.5096 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												3135.4162 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												346.8182 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-6000.4992 (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												5678.2449 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	8110.5096	0.2100	1703.2070 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3135.4162	0.2100	658.4374 (264)
Space and water heating			2361.6444 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	346.8182	0.1443	50.0566 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1828.1058	0.1358	-248.2058
PV Unit electricity exported	-4172.3934	0.1264	-527.4056
Total			-775.6114 (269)
Total CO2, kg/year			1648.0189 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			6.7900 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	8110.5096	1.1300	9164.8759 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3135.4162	1.1300	3543.0203 (278)
Space and water heating			12707.8962 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	346.8182	1.5338	531.9613 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1828.1058	1.5019	-2745.5518
PV Unit electricity exported	-4172.3934	0.4640	-1936.0313
Total			-4681.5831 (283)
Total Primary energy kWh/year			8688.3752 (286)
Target Primary Energy Rate (TPER)			35.7800 (287)

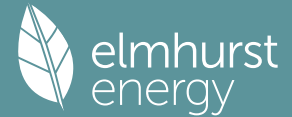
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF FABRIC ENERGY EFFICIENCY

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 594.8600 (5)



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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	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)
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	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	105.7123	92.4403	96.7014	82.7245	78.3610	68.7387	67.0300	71.0965	73.3265	83.9082	91.6700	104.3645		(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	0.0000	(63a)
FV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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)
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	0.0000	(63d)
Output from w/h	105.7123	92.4403	96.7014	82.7245	78.3610	68.7387	67.0300	71.0965	73.3265	83.9082	91.6700	104.3645		(64)
12Total per year (kWh/year)													1016.0740	(64)
Electric shower(s)	60.4511	53.8625	58.8157	56.1271	57.1803	54.5445	56.3626	57.1803	56.1271	58.8157	57.7098	60.4511		(64a)
													687.6280	(64a)
Heat gains from water heating, kWh/month	41.5409	36.5757	38.8793	34.7129	33.8853	30.8208	30.8482	32.0692	32.3634	35.6810	37.3449	41.2039		(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	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	206.8203	228.9797	206.8203	213.7144	206.8203	213.7144	206.8203	206.8203	213.7144	206.8203	213.7144	206.8203	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.0985	414.3540	403.6302	380.8004	351.9820	324.8967	306.8021	302.5465	313.2704	336.1001	364.9185	392.0038	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	(71)
Water heating gains (Table 5)	55.8345	54.4281	52.2571	48.2124	45.5448	42.8067	41.4626	43.1038	44.9492	47.9583	51.8680	55.3816	(72)
Total internal gains	741.6169	766.6253	731.5712	711.5907	673.2107	650.2813	623.9486	621.3342	640.7974	659.7423	699.3644	723.0693	(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	6.0700	11.2829	0.7200	0.7000	0.7700	23.9207 (75)							
Southeast	30.3100	36.7938	0.7200	0.7000	0.7700	389.5155 (77)							
Northwest	2.8800	11.2829	0.7200	0.7000	0.7700	11.3495 (81)							
Southeast	9.1200	39.9751	0.7200	0.7000	1.0000	165.3704 (82)							
Northwest	3.6000	16.3666	0.7200	0.7000	1.0000	26.7260 (82)							
Solar gains	616.8822	1094.2754	1602.4046	2144.8028	2535.5445	2572.5201	2457.4070	2159.6051	1790.3905	1238.7651	747.0551	522.4984	(83)
Total gains	1358.4990	1860.9007	2333.9758	2856.3935	3208.7552	3222.8014	3081.3556	2780.9393	2431.1879	1898.5074	1446.4196	1245.5677	(84)

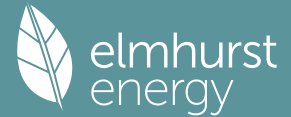
## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	71.2557	71.3382	71.4193	71.8026	71.8748	72.2127	72.2127	72.2756	72.0822	71.8748	71.7289	71.5771		
alpha	5.7504	5.7559	5.7613	5.7868	5.7917	5.8142	5.8142	5.8184	5.8055	5.7917	5.7819	5.7718		
util living area	0.9986	0.9916	0.9621	0.8504	0.6548	0.4608	0.3330	0.3850	0.6418	0.9366	0.9950	0.9991	(86)	
MIT	19.8164	20.1059	20.4627	20.8117	20.9632	20.9958	20.9995	20.9988	20.9755	20.6977	20.1652	19.7616	(87)	
Th 2	20.1046	20.1055	20.1064	20.1108	20.1116	20.1154	20.1154	20.1161	20.1139	20.1116	20.1100	20.1082	(88)	
util rest of house	0.9981	0.9890	0.9509	0.8157	0.6003	0.3984	0.2663	0.3115	0.5682	0.9121	0.9930	0.9988	(89)	
MIT 2	19.0173	19.3056	19.6534	19.9726	20.0900	20.1137	20.1153	20.1158	20.1023	19.8834	19.3694	18.9656	(90)	
Living area fraction										FLA = Living area / (4) =			0.1277	(91)
MIT	19.1194	19.4078	19.7568	20.0798	20.2015	20.2263	20.2282	20.2285	20.2138	19.9874	19.4710	19.0672	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.1194	19.4078	19.7568	20.0798	20.2015	20.2263	20.2282	20.2285	20.2138	19.9874	19.4710	19.0672	(93)	

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.9974	0.9862	0.9456	0.8144	0.6059	0.4063	0.2748	0.3209	0.5768	0.9080	0.9911	0.9983	(94)	
Useful gains	1354.9285	1835.2486	2207.0367	2326.2695	1944.3442	1309.4737	846.8119	892.3372	1402.3166	1723.9242	1433.4870	1243.5095	(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	3506.6819	3428.9786	3129.7362	2625.2946	1994.3711	1313.7008	847.1491	893.1555	1430.1176	2202.1801	2908.0047	3502.2113	(97)	
Space heating kWh	1600.9045	1070.9866	686.4884	215.2981	37.2200	0.0000	0.0000	0.0000	0.0000	355.8224	1061.6527	1680.4742	(98a)	
Space heating requirement - total per year (kWh/year)												6708.8469		
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	1600.9045	1070.9866	686.4884	215.2981	37.2200	0.0000	0.0000	0.0000	0.0000	355.8224	1061.6527	1680.4742	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												6708.8469		
Space heating per m2												(98c) / (4) =	27.6312	(99)

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## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2194.8274	1727.8429	1772.9964	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9741	0.9895	0.9809	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2138.0801	1709.7165	1739.1882	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh						979.4776	1217.0699	954.5239	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000				fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh						244.8694	304.2675	238.6310	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												787.7679 (107)
Energy for space heating												27.6312 (99)
Energy for space cooling												3.2445 (108)
Total												30.8757 (109)
Fabric Energy Efficiency (DFEE)												30.9 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	594.8600 (5)

## 2. Ventilation rate

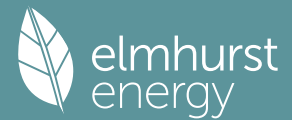
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0672 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3172	(18)
Number of sides sheltered	1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2934 (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	0.3741	0.3668	0.3595	0.3228	0.3155	0.2788	0.2788	0.2714	0.2934	0.3155	0.3301	0.3448 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5700	0.5673	0.5646	0.5521	0.5498	0.5389	0.5389	0.5368	0.5431	0.5498	0.5545	0.5594 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Semi-glazed door			2.4000	1.0000	2.4000		(26a)
TER Opening Type (Uw = 1.20)			39.2600	1.1450	44.9542		(27)
NW Rooflight			3.6000	1.4151	5.0943		(27a)
SE Rooflight			9.1200	1.4151	12.9057		(27a)
Floor			121.4000	0.1300	15.7820		(28a)
Wall	175.7300	41.6600	134.0700	0.1800	24.1326		(29a)
Roof	172.6600	12.7200	159.9400	0.1100	17.5934		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			469.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	122.8622	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				19.9600	0.0500	0.9980	
E3 Sill				5.2000	0.0500	0.2600	
E4 Jamb				31.2000	0.0500	1.5600	
E5 Ground floor (normal)				49.1000	0.1600	7.8560	

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E6 Intermediate floor within a dwelling	49.1000	0.0000	0.0000
E16 Corner (normal)	12.4000	0.0900	1.1160
R1 Head of roof window	7.4000	0.0800	0.5920
R2 Sill of roof window	4.2000	0.0600	0.2520
R3 Jamb of roof window	36.0000	0.0800	2.8800
E11 Eaves (insulation at rafter level)	35.6000	0.0400	1.4240
E13 Gable (insulation at rafter level)	19.4000	0.0800	1.5520
R4 Ridge (vaulted ceiling)	17.8000	0.0800	1.4240

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
 Point Thermal bridges (36a) = 19.9140 (36)  
 Total fabric heat loss (33) + (36) + (36a) = 142.7762 (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	111.8919	111.3583	110.8354	108.3790	107.9194	105.7799	105.7799	105.3837	106.6040	107.9194	108.8491	109.8211 (38)
Average = Sum(39)m / 12 =	254.6681	254.1345	253.6116	251.1552	250.6956	248.5561	248.5561	248.1599	249.3802	250.6956	251.6253	252.5973 (39)
												251.1530

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0489	1.0467	1.0445	1.0344	1.0325	1.0237	1.0237	1.0221	1.0271	1.0325	1.0363	1.0404 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													3.0576 (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	32.5844	32.1004	31.4190	30.1625	29.2216	28.1784	27.6148	28.2915	29.0283	30.1447	31.4270	32.4742 (42b)	
Hot water usage for other uses	45.9426	44.2719	42.6013	40.9307	39.2600	37.5894	37.5894	39.2600	40.9307	42.6013	44.2719	45.9426 (42c)	
Average daily hot water use (litres/day)													71.9768 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy cont	78.5269	76.3724	74.0203	71.0931	68.4816	65.7677	65.2042	67.5516	69.9590	72.7460	75.6990	78.4168 (44)	
Energy content (annual)	124.3675	108.7532	113.7664	97.3229	92.1894	80.8691	78.8589	83.6429	86.2664	98.7156	107.8471	122.7817 (45)	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)	
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month	105.7123	92.4403	96.7014	82.7245	78.3610	68.7387	67.0300	71.0965	73.3265	83.9082	91.6700	104.3645 (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	105.7123	92.4403	96.7014	82.7245	78.3610	68.7387	67.0300	71.0965	73.3265	83.9082	91.6700	104.3645 (64)	
12Total per year (kWh/year)													1016.0740 (64)
Electric shower(s)	60.4511	53.8625	58.8157	56.1271	57.1803	54.5445	56.3626	57.1803	56.1271	58.8157	57.7098	60.4511 (64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													687.6280 (64a)
Heat gains from water heating, kWh/month	41.5409	36.5757	38.8793	34.7129	33.8853	30.8208	30.8482	32.0692	32.3634	35.6810	37.3449	41.2039 (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	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785	152.8785 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	206.8203	228.9797	206.8203	213.7144	206.8203	213.7144	206.8203	206.8203	213.7144	206.8203	213.7144	206.8203 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.0985	414.3540	403.6302	380.8004	351.9820	324.8967	306.8021	302.5465	313.2704	336.1001	364.9185	392.0038 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878	38.2878 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028 (71)
Water heating gains (Table 5)	55.8345	54.4281	52.2571	48.2124	45.5448	42.8067	41.4626	43.1038	44.9492	47.9583	51.8680	55.3816 (72)
Total internal gains	741.6169	766.6253	731.5712	711.5907	673.2107	650.2813	623.9486	621.3342	640.7974	659.7423	699.3644	723.0693 (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	6.0700	11.2829	0.6300	0.7000	0.7700	20.9307 (75)						
Southeast	30.3100	36.7938	0.6300	0.7000	0.7700	340.8261 (77)						
Northwest	2.8800	11.2829	0.6300	0.7000	0.7700	9.9309 (81)						
Southeast	9.1200	39.9751	0.6300	0.7000	1.0000	144.6991 (82)						
Northwest	3.6000	16.3666	0.6300	0.7000	1.0000	23.3852 (82)						
Solar gains	539.7719	957.4910	1402.1041	1876.7024	2218.6014	2250.9551	2150.2312	1889.6545	1566.5917	1083.9195	653.6732	457.1861 (83)
Total gains	1281.3888	1724.1163	2133.6752	2588.2931	2891.8121	2901.2364	2774.1797	2510.9887	2207.3891	1743.6618	1353.0377	1180.2554 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	66.2082	66.3472	66.4840	67.1342	67.2573	67.8362	67.8362	67.9445	67.6121	67.2573	67.0088	66.7510
alpha	5.4139	5.4231	5.4323	5.4756	5.4838	5.5224	5.5224	5.5296	5.5075	5.4838	5.4673	5.4501
util living area	0.9989	0.9946	0.9775	0.9047	0.7425	0.5392	0.3928	0.4514	0.7252	0.9606	0.9966	0.9993 (86)
MIT	19.6628	19.9306	20.2835	20.6855	20.9169	20.9880	20.9982	20.9964	20.9458	20.5794	20.0311	19.6196 (87)
Th 2	20.0428	20.0446	20.0464	20.0548	20.0563	20.0636	20.0636	20.0650	20.0608	20.0563	20.0532	20.0498 (88)
util rest of house	0.9986	0.9929	0.9701	0.8770	0.6855	0.4643	0.3100	0.3614	0.6464	0.9432	0.9952	0.9991 (89)
MIT 2	18.8151	19.0830	19.4317	19.8150	20.0056	20.0587	20.0632	20.0640	20.0339	19.7287	19.1908	18.7774 (90)
Living area fraction	FLA = Living area / (4) =											0.1277 (91)
MIT	18.9233	19.1913	19.5404	19.9261	20.1219	20.1773	20.1826	20.1831	20.1503	19.8374	19.2981	18.8850 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9233	19.1913	19.5404	19.9261	20.1219	20.1773	20.1826	20.1831	20.1503	19.8374	19.2981	18.8850 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9980	0.9907	0.9651	0.8727	0.6898	0.4736	0.3206	0.3729	0.6545	0.9380	0.9936	0.9987 (94)
Useful gains	1278.7794	1708.0524	2059.2117	2258.6869	1994.6307	1373.9164	889.3356	936.2501	1444.7046	1635.6217	1344.4051	1178.6870 (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	3724.0856	3631.9017	3307.1991	2769.2686	2111.3432	1386.2751	890.4742	938.8045	1508.8361	2315.7647	3069.3458	3709.3797 (97)
Space heating kWh	1819.3078	1292.8267	928.5027	367.6188	86.8341	0.0000	0.0000	0.0000	0.0000	506.0264	1241.9573	1882.8354 (98a)
Space heating requirement - total per year (kWh/year)												8125.9092
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	1819.3078	1292.8267	928.5027	367.6188	86.8341	0.0000	0.0000	0.0000	0.0000	506.0264	1241.9573	1882.8354 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8125.9092
Space heating per m2												(98c) / (4) = 33.4675 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2336.4277	1839.3154	1886.0156	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9417	0.9732	0.9557	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2200.3307	1790.0044	1802.4693	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3144.0796	3006.9283	2724.0862	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	679.4992	905.3914	685.6830	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	FC = cooled area / (4) =											1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	169.8748	226.3478	171.4208	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												567.6434 (107)
Energy for space heating												33.4675 (99)
Energy for space cooling												2.3379 (108)
Total												35.8054 (109)
Fabric Energy Efficiency (TFEE)												35.8 (109)

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

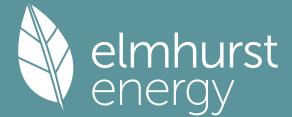
### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	594.8600 (5)

### 2. Ventilation rate

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

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour	0.0000 / (5) =	0.0000 (8)
Pressure test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50												3.2000	(17)	
Infiltration rate												0.1600	(18)	
Number of sides sheltered												1	(19)	
Shelter factor												(20) = 1 - [0.075 x (19)] =	0.9250 (20)	
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.1480 (21)	

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1887	0.1850	0.1813	0.1628	0.1591	0.1406	0.1406	0.1369	0.1480	0.1591	0.1665	0.1739	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													78.3000 (23c)
Effective ac	0.2972	0.2935	0.2898	0.2713	0.2676	0.2491	0.2491	0.2454	0.2565	0.2676	0.2750	0.2824	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			39.2600	1.1450	44.9542		(27)
Door			2.4000	1.4000	3.3600		(26a)
NW Rooflight			3.6000	1.1450	4.1221		(27a)
SE Rooflight			9.1200	1.1450	10.4427		(27a)
Floor			121.4000	0.0900	10.9260		(28a)
Wall	175.7300	41.6600	134.0700	0.1700	22.7919		(29a)
Roof	172.6600	12.7200	159.9400	0.0800	12.7952		(30)
Total net area of external elements Aum(A, m2)			469.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.3922	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	19.9600	0.5800	11.5768
E2 Other lintels (including other steel lintels)	5.2000	0.0160	0.0832
E3 Sill	31.2000	0.0010	0.0312
E4 Jamb	49.1000	0.0520	2.5532
E5 Ground floor (normal)	49.1000	0.0010	0.0491
E6 Intermediate floor within a dwelling	12.4000	0.0370	0.4588
El6 Corner (normal)	7.4000	0.0610	0.4514
R1 Head of roof window	4.2000	0.0600	0.2520
R2 Sill of roof window	36.0000	0.0560	2.0160
R3 Jamb of roof window	35.6000	0.0480	1.7088
El1 Eaves (insulation at rafter level)	19.4000	0.0370	0.7178
El3 Gable (insulation at rafter level)	17.8000	0.1200	2.1360
R4 Ridge (vaulted ceiling)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.0343 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 131.4265 (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	58.3415	57.6152	56.8888	53.2572	52.5309	48.8993	48.8993	48.1730	50.3519	52.5309	53.9835	55.4362 (38)
Average = Sum(39)m / 12 =	189.7680	189.0416	188.3153	184.6837	183.9574	180.3258	180.3258	179.5994	181.7784	183.9574	185.4100	186.8627 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7816	0.7786	0.7756	0.7606	0.7576	0.7427	0.7427	0.7397	0.7487	0.7576	0.7636	0.7696 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

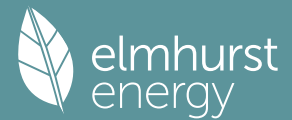
Assumed occupancy													3.0576 (42)
Hot water usage for mixer showers													103.7923
Hot water usage for baths													32.5844
Hot water usage for other uses													45.9426
Average daily hot water use (litres/day)													167.6698 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	182.3192	178.6048	173.9798	166.7038	160.8830	154.5901	151.9922	156.5953	161.4754	168.1052	175.5004	181.8114 (44)	
Energy content (annual)	288.7490	254.3309	267.4005	228.2092	216.5794	190.0865	183.8215	193.8977	199.1154	228.1172	250.0326	284.6726 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2785.0124
Water storage loss:													43.3124
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7500 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9450 (55)
Total storage loss	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (56)	
If cylinder contains dedicated solar storage													29.2950
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (57)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)	
Total heat required for water heating calculated for each month	341.3064	301.8021	319.9579	279.0712	269.1368	240.9485	236.3789	246.4551	249.9774	280.6746	300.8946	337.2300 (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)	



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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	341.3064	301.8021	319.9579	279.0712	269.1368	240.9485	236.3789	246.4551	249.9774	280.6746	300.8946	337.2300	(64)
	Total per year (kWh/year) = Sum(64)m =											3403.8334 (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	138.0550	122.5420	130.9566	116.5692	114.0586	103.8934	103.1666	106.5169	106.8955	117.8949	123.8254	136.6996	(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	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.1791	42.7923	34.8010	26.3466	19.6944	16.6268	17.9659	23.3527	31.3440	39.7984	46.4506	49.5182	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	612.0873	618.4388	602.4331	568.3589	525.3462	484.9205	457.9135	451.5620	467.5677	501.6419	544.6545	585.0803	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	(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)	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	(71)
Water heating gains (Table 5)	185.5578	182.3541	176.0169	161.9016	153.3045	144.2964	138.6647	143.1679	148.4659	158.4609	171.9798	183.7360	(72)
Total internal gains	966.3785	964.1396	933.8054	877.1615	818.8996	763.3980	732.0985	735.6370	764.9320	820.4556	883.6393	938.8889	(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	6.0700	11.2829	0.7200	0.7000	0.7700	23.9207 (75)							
Southeast	30.3100	36.7938	0.7200	0.7000	0.7700	389.5155 (77)							
Northwest	2.8800	11.2829	0.7200	0.7000	0.7700	11.3495 (81)							
Southeast	9.1200	39.9751	0.7200	0.7000	1.0000	165.3704 (82)							
Northwest	3.6000	16.3666	0.7200	0.7000	1.0000	26.7260 (82)							
Solar gains	616.8822	1094.2754	1602.4046	2144.8028	2535.5445	2572.5201	2457.4070	2159.6051	1790.3905	1238.7651	747.0551	522.4984	(83)
Total gains	1583.2607	2058.4150	2536.2100	3021.9642	3354.4440	3335.9181	3189.5056	2895.2421	2555.3225	2059.2207	1630.6944	1461.3873	(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	88.8512	89.1926	89.5366	91.2972	91.6577	93.5036	93.5036	93.8818	92.7564	91.6577	90.9396	90.2326	
alpha	6.9234	6.9462	6.9691	7.0865	7.1105	7.2336	7.2336	7.2588	7.1838	7.1105	7.0626	7.0155	
util living area	0.9959	0.9776	0.9043	0.7146	0.5079	0.3459	0.2488	0.2853	0.4893	0.8422	0.9851	0.9975	(86)
MIT	20.3899	20.5890	20.8001	20.9293	20.9538	20.9569	20.9570	20.9571	20.9553	20.8924	20.6102	20.3574	(87)
Th 2	20.2693	20.2719	20.2745	20.2876	20.2902	20.3033	20.3033	20.3059	20.2980	20.2902	20.2850	20.2797	(88)
util rest of house	0.9946	0.9716	0.8841	0.6788	0.4699	0.3083	0.2094	0.2423	0.4402	0.8052	0.9802	0.9967	(89)
MIT 2	19.5487	19.8016	20.0570	20.2076	20.2323	20.2480	20.2481	20.2509	20.2417	20.1771	19.8417	19.5161	(90)
Living area fraction	fLA = Living area / (4) =											0.1277 (91)	
MIT	19.6561	19.9021	20.1518	20.2997	20.3244	20.3385	20.3386	20.3411	20.3328	20.2684	19.9398	19.6235	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6561	19.9021	20.1518	20.2997	20.3244	20.3385	20.3386	20.3411	20.3328	20.2684	19.9398	19.6235	(93)

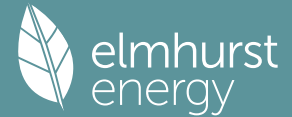
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9933	0.9679	0.8804	0.6794	0.4717	0.3102	0.2114	0.2445	0.4427	0.8040	0.9772	0.9958	(94)
Useful gains	1572.5880	1992.3042	2232.7945	2053.2395	1582.4325	1034.6561	674.1602	707.7950	1131.1554	1655.5709	1593.4348	1455.2173	(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	2914.0941	2836.0265	2570.8506	2105.3471	1586.5168	1034.8062	674.1672	707.8144	1132.9872	1778.5798	2380.6258	2882.0821	(97)
Space heating kWh	998.0806	566.9814	251.5138	37.5174	3.0388	0.0000	0.0000	0.0000	0.0000	91.5186	566.7776	1061.5874	(98a)
Space heating requirement - total per year (kWh/year)												3577.0155	
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	998.0806	566.9814	251.5138	37.5174	3.0388	0.0000	0.0000	0.0000	0.0000	91.5186	566.7776	1061.5874	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3577.0155	
Space heating per m2												(98c) / (4) = 14.7324 (99)	

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)	
Fraction of space heat from main system(s)												1.0000 (202)	
Efficiency of main space heating system 1 (in %)												249.9000 (206)	
Efficiency of main space heating system 2 (in %)												0.0000 (207)	
Efficiency of secondary/supplementary heating system, %												0.0000 (208)	
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	998.0806	566.9814	251.5138	37.5174	3.0388	0.0000	0.0000	0.0000	0.0000	91.5186	566.7776	1061.5874	(98)

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Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Space heating fuel (main heating system)	399.3920	226.8833	100.6458	15.0130	1.2160	0.0000	0.0000	0.0000	36.6221	226.8017	424.8049	(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	(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	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating												
Water heating requirement	341.3064	301.8021	319.9579	279.0712	269.1368	240.9485	236.3789	246.4551	249.9774	280.6746	300.8946	337.2300 (64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	194.9209	172.3598	182.7286	159.3782	153.7046	137.6062	134.9965	140.7511	142.7626	160.2939	171.8416	192.5928 (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	48.3236	43.6471	48.3236	46.7648	48.3236	46.7648	48.3236	48.3236	46.7648	48.3236	46.7648	48.3236 (231)
Lighting	42.1709	33.8311	30.4611	22.3171	17.2384	14.0839	15.7254	20.4405	26.5502	34.8353	39.3464	43.3430 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-82.1565	-132.2539	-212.6333	-260.2081	-296.9236	-282.7023	-278.7353	-255.4802	-213.6754	-159.8446	-95.4198	-68.8986 (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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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												1431.3788 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1943.9369 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7840)												
mechanical ventilation fans (SFP = 0.7840)												568.9717 (230a)
Total electricity for the above, kWh/year												568.9717 (231)
Electricity for lighting (calculated in Appendix L)												340.3433 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2338.9317 (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												1945.6989 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	858.8273	17.2320	176.4031 (240)
Space heating - main system 1 (low-rate cost)	572.5515	0.1227	70.2521 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (electric off-peak tariff)			
High-rate fraction			0.7000 (243)
Low-rate fraction			0.3000 (244)
High-rate cost	1360.7558	20.5400	279.4992 (245)
Low-rate cost	583.1811	12.2700	71.5563 (246)
Energy for instantaneous electric shower(s)	0.0000	18.8860	0.0000 (247a)
Pumps, fans and electric keep-hot (0.80*20.54 + 0.20*12.27)	568.9717	18.8860	97.1041 (249)
Energy for lighting (0.80*20.54 + 0.20*12.27)	340.3433	18.8860	64.2772 (250)
Additional standing charges			21.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2338.9317	18.8860	-441.7306
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-441.7306 (252)
Total energy cost			338.3615 (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] =	0.4232 (257)
SAP value		93.1392
SAP rating (Section 12)		93 (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 (high-rate cost)	858.8273	0.1641	140.9013 (261)
Space heating - main system 1 (low-rate cost)	572.5515	0.1515	86.7153 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	1360.7558	0.1458	198.3793 (264)
Water heating - low rate cost	583.1811	0.1345	78.4550 (264)

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Space and water heating			504.4510 (265)
Pumps, fans and electric keep-hot	568.9717	0.1412	78.9304 (267)
Energy for lighting	340.3433	0.1468	49.9765 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2338.9317	0.1351	-316.0280
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-316.0280 (269)
Total CO2, kg/year			317.3299 (272)
CO2 emissions per m2			1.3100 (273)
EI value			98.5225
EI rating			99 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 594.8600 (5)

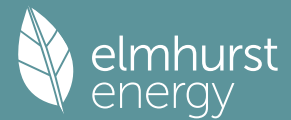
### 2. Ventilation rate

	m3 per hour												
Number of open chimneys	0 * 80 =											0.0000 (6a)	
Number of open flues	0 * 20 =											0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)	
Number of blocked chimneys	0 * 20 =											0.0000 (6f)	
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												3.2000 (17)	
Infiltration rate												0.1600 (18)	
Number of sides sheltered												1 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =											0.9250 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.1480 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.8000	5.5000	5.5000	5.0000	4.9000	4.3000	4.4000	4.2000	4.5000	5.1000	5.2000	5.7000	(22)
Wind factor	1.4500	1.3750	1.3750	1.2500	1.2250	1.0750	1.1000	1.0500	1.1250	1.2750	1.3000	1.4250	(22a)
Adj infilt rate	0.2146	0.2035	0.2035	0.1850	0.1813	0.1591	0.1628	0.1554	0.1665	0.1887	0.1924	0.2109	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													78.3000 (23c)
Effective ac	0.3231	0.3120	0.3120	0.2935	0.2898	0.2676	0.2713	0.2639	0.2750	0.2972	0.3009	0.3194	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			39.2600	1.1450	44.9542		(27)
Door			2.4000	1.4000	3.3600		(26a)
NW Rooflight			3.6000	1.1450	4.1221		(27a)
SE Rooflight			9.1200	1.1450	10.4427		(27a)
Floor			121.4000	0.0900	10.9260		(28a)
Wall	175.7300	41.6600	134.0700	0.1700	22.7919		(29a)
Roof	172.6600	12.7200	159.9400	0.0800	12.7952		(30)
Total net area of external elements Aum(A, m2)			469.7900				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	109.3922			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
List of Thermal Bridges							
K1 Element			Length	Psi-value	Total		
E2 Other lintels (including other steel lintels)			19.9600	0.5800	11.5768		
E3 Sill			5.2000	0.0160	0.0832		
E4 Jamb			31.2000	0.0010	0.0312		
E5 Ground floor (normal)			49.1000	0.0520	2.5532		
E6 Intermediate floor within a dwelling			49.1000	0.0010	0.0491		
E16 Corner (normal)			12.4000	0.0370	0.4588		
R1 Head of roof window			7.4000	0.0610	0.4514		
R2 Sill of roof window			4.2000	0.0600	0.2520		
R3 Jamb of roof window			36.0000	0.0560	2.0160		
E11 Eaves (insulation at rafter level)			35.6000	0.0480	1.7088		
E13 Gable (insulation at rafter level)			19.4000	0.0370	0.7178		

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R4 Ridge (vaulted ceiling) 17.8000 0.1200 2.1360  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.0343 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 131.4265 (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 63.4258 61.2468 61.2468 57.6152 56.8888 52.5309 53.2572 51.8046 53.9835 58.3415 59.0678 62.6994 (38)  
 Average = Sum(39)m / 12 = 194.8522 192.6733 192.6733 189.0416 188.3153 183.9574 184.6837 183.2311 185.4100 189.7680 190.4943 194.1259 (39)  
 194.8522 192.6733 192.6733 189.0416 188.3153 183.9574 184.6837 183.2311 185.4100 189.7680 190.4943 194.1259 (39)  
 189.1022

HLP Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 HLP (average) 0.8025 0.7935 0.7935 0.7786 0.7756 0.7576 0.7606 0.7547 0.7636 0.7816 0.7846 0.7995 (40)  
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

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

Assumed occupancy 3.0576 (42)  
 Hot water usage for mixer showers 103.7923 102.2325 99.9595 95.6107 92.4014 88.8223 86.7880 89.0437 91.5164 95.3592 99.8015 103.3946 (42a)  
 Hot water usage for baths 32.5844 32.1004 31.4190 30.1625 29.2216 28.1784 27.6148 28.2915 29.0283 30.1447 31.4270 32.4742 (42b)  
 Hot water usage for other uses 45.9426 44.2719 42.6013 40.9307 39.2600 37.5894 37.5894 39.2600 40.9307 42.6013 44.2719 45.9426 (42c)  
 Average daily hot water use (litres/day) 45.9426 44.2719 42.6013 40.9307 39.2600 37.5894 37.5894 39.2600 40.9307 42.6013 44.2719 45.9426 (43)  
 Daily hot water use Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 Energy conte 182.3192 178.6048 173.9798 166.7038 160.8830 154.5901 151.9922 156.5953 161.4754 168.1052 175.5004 181.8114 (44)  
 Energy content (annual) 288.7490 254.3309 267.4005 228.2092 216.5794 190.0865 183.8215 193.8977 199.1154 228.1172 250.0326 284.6726 (45)  
 Distribution loss (46)m = 0.15 x (45)m Total = Sum(45)m = 2785.0124  
 43.3124 38.1496 40.1101 34.2314 32.4869 28.5130 27.5732 29.0847 29.8673 34.2176 37.5049 42.7009 (46)  
 Water storage loss:  
 Store volume 210.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 1.7500 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 0.9450 (55)  
 29.2950 26.4600 29.2950 28.3500 29.2950 28.3500 29.2950 29.2950 28.3500 29.2950 28.3500 29.2950 (56)  
 If cylinder contains dedicated solar storage  
 Primary loss 29.2950 26.4600 29.2950 28.3500 29.2950 28.3500 29.2950 29.2950 28.3500 29.2950 28.3500 29.2950 (57)  
 Combi loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 (59)  
 Total heat required for water heating calculated for each month  
 WWHRs 341.3064 301.8021 319.9579 279.0712 269.1368 240.9485 236.3789 246.4551 249.9774 280.6746 300.8946 337.2300 (62)  
 PV diverter 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)  
 Solar input -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)  
 FGHRs 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)  
 Output from w/h 341.3064 301.8021 319.9579 279.0712 269.1368 240.9485 236.3789 246.4551 249.9774 280.6746 300.8946 337.2300 (64)  
 Total per year (kWh/year) = Sum(64)m = 3403.8334 (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 138.0550 122.5420 130.9566 116.5692 114.0586 103.8934 103.1666 106.5169 106.8955 117.8949 123.8254 136.6996 (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 48.1791 42.7923 34.8010 26.3466 19.6944 16.6268 17.9659 23.3527 31.3440 39.7984 46.4506 49.5182 (67)  
 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 612.0873 618.4388 602.4331 568.3589 525.3462 484.9205 457.9135 451.5620 467.5677 501.6419 544.6545 585.0803 (68)  
 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 56.4030 (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) -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 -122.3028 (71)  
 Water heating gains (Table 5) 185.5578 182.3541 176.0169 161.9016 153.3045 144.2964 138.6647 143.1679 148.4659 158.4609 171.9798 183.7360 (72)  
 Total internal gains 966.3785 964.1396 933.8054 877.1615 818.8996 763.3980 732.0985 735.6370 764.9320 820.4556 883.6393 938.8889 (73)

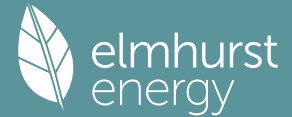
## 6. Solar gains

[Jan] Area Solar flux g Specific data FF Access Gains  
 m2 Table 6a W/m2 or Table 6b or Table 6c factor Table 6d W  
 Northeast 6.0700 15.4538 0.7200 0.7000 0.7700 32.7633 (75)  
 Southeast 30.3100 47.2368 0.7200 0.7000 0.7700 500.0694 (77)  
 Northwest 2.8800 15.4538 0.7200 0.7000 0.7700 15.5450 (81)  
 Southeast 9.1200 52.7967 0.7200 0.7000 1.0000 218.4112 (82)  
 Northwest 3.6000 22.4937 0.7200 0.7000 1.0000 36.7314 (82)

Solar gains 803.5203 1187.3394 1706.5560 2344.1459 2604.1752 2839.7188 2430.0840 2333.6712 1975.3021 1352.8227 916.6790 701.6404 (83)  
 Total gains 1769.8988 2151.4790 2640.3614 3221.3073 3423.0747 3603.1168 3162.1825 3069.3082 2740.2341 2173.2782 1800.3183 1640.5293 (84)

## 7. Mean internal temperature (heating season)

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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	86.5328	87.5114	87.5114	89.1926	89.5366	91.6577	91.2972	92.0210	90.9396	88.8512	88.5124	86.8566
alpha	6.7689	6.8341	6.8341	6.9462	6.9691	7.1105	7.0865	7.1347	7.0626	6.9234	6.9008	6.7904
util living area	0.9891	0.9657	0.8815	0.6945	0.5252	0.3572	0.3095	0.3163	0.4790	0.7965	0.9645	0.9920 (86)
MIT	20.4984	20.6463	20.8235	20.9307	20.9518	20.9561	20.9561	20.9563	20.9546	20.9094	20.7060	20.4793 (87)
Th 2	20.2511	20.2589	20.2589	20.2719	20.2745	20.2902	20.2876	20.2928	20.2850	20.2693	20.2667	20.2537 (88)
util rest of house	0.9858	0.9565	0.8575	0.6585	0.4865	0.3211	0.2679	0.2742	0.4314	0.7530	0.9530	0.9894 (89)
MIT 2	19.6710	19.8611	20.0686	20.1929	20.2146	20.2340	20.2312	20.2368	20.2276	20.1732	19.9436	19.6494 (90)
Living area fraction									fLA = Living area / (4) =			0.1277 (91)
MIT	19.7766	19.9613	20.1649	20.2871	20.3088	20.3262	20.3238	20.3287	20.3205	20.2672	20.0409	19.7553 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7766	19.9613	20.1649	20.2871	20.3088	20.3262	20.3238	20.3287	20.3205	20.2672	20.0409	19.7553 (93)

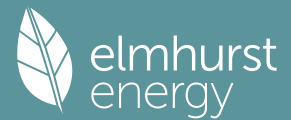
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9831	0.9522	0.8542	0.6593	0.4884	0.3229	0.2700	0.2763	0.4337	0.7529	0.9488	0.9872 (94)
Useful gains	1739.9309	2048.6188	2255.3682	2123.7248	1671.6961	1163.4875	853.8791	848.0594	1188.5496	1636.2515	1708.1119	1619.4564 (95)
Ext temp.	5.4000	5.7000	7.0000	8.8000	11.4000	14.0000	15.7000	15.7000	13.9000	11.2000	8.2000	5.7000 (96)
Heat loss rate W	2801.3182	2747.7764	2536.5319	2171.5367	1677.6560	1163.7425	853.9374	848.1229	1190.4178	1720.6648	2255.6296	2728.5064 (97)
Space heating kWh	789.6721	469.8339	209.1858	34.4246	4.4342	0.0000	0.0000	0.0000	0.0000	62.8035	394.2127	825.1332 (98a)
Space heating requirement - total per year (kWh/year)												2789.7000
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	789.6721	469.8339	209.1858	34.4246	4.4342	0.0000	0.0000	0.0000	0.0000	62.8035	394.2127	825.1332 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2789.7000
Space heating per m2												(98c) / (4) = 11.4897 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												249.9000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	789.6721	469.8339	209.1858	34.4246	4.4342	0.0000	0.0000	0.0000	0.0000	62.8035	394.2127	825.1332 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	315.9952	188.0088	83.7078	13.7753	1.7744	0.0000	0.0000	0.0000	0.0000	25.1315	157.7482	330.1854 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	341.3064	301.8021	319.9579	279.0712	269.1368	240.9485	236.3789	246.4551	249.9774	280.6746	300.8946	337.2300 (64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	194.9209	172.3598	182.7286	159.3782	153.7046	137.6062	134.9965	140.7511	142.7626	160.2939	171.8416	192.5928 (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	48.3236	43.6471	48.3236	46.7648	46.7648	46.7648	48.3236	48.3236	46.7648	48.3236	46.7648	48.3236 (221)
Lighting	42.1709	33.8311	30.4611	22.3171	17.2384	14.0839	15.7254	20.4405	26.5502	34.8353	39.3464	43.3430 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-107.1999	-144.6274	-226.3905	-278.6734	-302.8241	-299.6340	-277.4465	-269.6229	-231.5789	-174.6328	-116.8512	-92.7625 (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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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												1116.3265 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1943.9369 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7840)												
mechanical ventilation fans (SFP = 0.7840)												568.9717 (230a)
Total electricity for the above, kWh/year												568.9717 (231)
Electricity for lighting (calculated in Appendix L)												340.3433 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2522.2440 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	1447.3343 (238)

## 10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	669.7959	29.3660	248.5613 (240)
Space heating - main system 1 (low-rate cost)	446.5306	0.1775	79.2592 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (electric off-peak tariff)			
High-rate fraction			0.7000 (243)
Low-rate fraction			0.3000 (244)
High-rate cost	1360.7558	37.1100	504.9765 (245)
Low-rate cost	583.1811	17.7500	103.5146 (246)
Energy for instantaneous electric shower(s)	0.0000	33.2380	0.0000 (247a)
Pumps, fans and electric keep-hot (0.80*37.11 + 0.20*17.75)	568.9717	33.2380	164.8812 (249)
Energy for lighting (0.80*37.11 + 0.20*17.75)	340.3433	33.2380	113.1233 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2522.2440	33.2380	-838.3435
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-838.3435 (252)
Total energy cost			467.9726 (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 (high-rate cost)	669.7959	0.1642	109.9930 (261)
Space heating - main system 1 (low-rate cost)	446.5306	0.1516	67.6953 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	1360.7558	0.1458	198.3793 (264)
Water heating - low rate cost	583.1811	0.1345	78.4550 (264)
Space and water heating			454.5226 (265)
Pumps, fans and electric keep-hot	568.9717	0.1412	78.9304 (267)
Energy for lighting	340.3433	0.1468	49.9765 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2522.2440	0.1359	-342.8631
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-342.8631 (269)
Total CO2, kg/year			240.5664 (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 (high-rate cost)	669.7959	0.9668	1079.2345 (275)
Space heating - main system 1 (low-rate cost)	446.5306	1.5577	695.5807 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating - high rate cost	1360.7558	1.5430	2099.6712 (278)
Water heating - low rate cost	583.1811	1.4917	869.9087 (278)
Space and water heating			4744.3952 (279)
Pumps, fans and electric keep-hot	568.9717	1.5239	860.6712 (281)
Energy for lighting	340.3433	1.5451	525.8552 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2522.2440	1.5044	-3794.5186
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-3794.5186 (283)
Total Primary energy kWh/year			2336.4029 (286)

## SAP 10 EPC IMPROVEMENTS

23-S936

Current energy efficiency rating: A 93  
 Current environmental impact rating: A 99

N Solar water heating Recommended  
 U Solar photovoltaic panels Already installed  
 V2 Wind turbine Not applicable

Recommended measures:  
 N Solar water heating SAP change + 1.0 Cost change -£ 100 CO2 change -42 kg (17.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£100	0.17 kg/m <sup>2</sup>	A 94 A 99
<b>Total Savings</b>	<b>£100</b>	<b>0.17 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 94  
 Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

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Electricity	£1306	£1190	£116
Space heating	£585	£611	-£27
Water heating	£608	£466	£143
Lighting	£113	£113	£0
Generated (PV)	-£838	-£822	-£16
Total cost of fuels	£468	£368	£100
Total cost of uses	£468	£368	£100
Delivered energy	6 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>	1 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.2 tonnes	0.2 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	1 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	10 kWh/m <sup>2</sup>	8 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 594.8600 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.2000 (17)
Infiltration rate	0.1600 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1480 (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	0.1887	0.1850	0.1813	0.1628	0.1591	0.1406	0.1406	0.1369	0.1480	0.1591	0.1665	0.1739 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												78.3000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2972	0.2935	0.2898	0.2713	0.2676	0.2491	0.2491	0.2454	0.2565	0.2676	0.2750	0.2824 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			39.2600	1.1450	44.9542		(27)
Door			2.4000	1.4000	3.3600		(26a)
NW Rooflight			3.6000	1.1450	4.1221		(27a)
SE Rooflight			9.1200	1.1450	10.4427		(27a)
Floor			121.4000	0.0900	10.9260		(28a)
Wall	175.7300	41.6600	134.0700	0.1700	22.7919		(29a)
Roof	172.6600	12.7200	159.9400	0.0800	12.7952		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			469.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	109.3922	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)

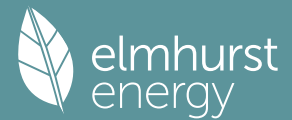
### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.9600	0.5800	11.5768
E3 Sill	5.2000	0.0160	0.0832
E4 Jamb	31.2000	0.0010	0.0312
E5 Ground floor (normal)	49.1000	0.0520	2.5532
E6 Intermediate floor within a dwelling	49.1000	0.0010	0.0491
E16 Corner (normal)	12.4000	0.0370	0.4588
R1 Head of roof window	7.4000	0.0610	0.4514
R2 Sill of roof window	4.2000	0.0600	0.2520
R3 Jamb of roof window	36.0000	0.0560	2.0160
E11 Eaves (insulation at rafter level)	35.6000	0.0480	1.7088





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			W/m2	or Table 6b	or Table 6c	Table 6d	
Northeast		6.0700	11.2829	0.7200	0.7000	0.7700	23.9207 (75)
Southeast		30.3100	36.7938	0.7200	0.7000	0.7700	389.5155 (77)
Northwest		2.8800	11.2829	0.7200	0.7000	0.7700	11.3495 (81)
Southeast		9.1200	39.9751	0.7200	0.7000	1.0000	165.3704 (82)
Northwest		3.6000	16.3666	0.7200	0.7000	1.0000	26.7260 (82)

Solar gains	616.8822	1094.2754	1602.4046	2144.8028	2535.5445	2572.5201	2457.4070	2159.6051	1790.3905	1238.7651	747.0551	522.4984 (83)
Total gains	1583.2607	2058.4150	2534.7092	3014.4602	3340.6867	3321.9107	3175.4981	2882.2352	2549.3193	2057.7199	1630.6944	1461.3873 (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	88.8512	89.1926	89.5366	91.2972	91.6577	93.5036	93.5036	93.8818	92.7564	91.6577	90.9396	90.2326
alpha	6.9234	6.9462	6.9691	7.0865	7.1105	7.2336	7.2336	7.2588	7.1838	7.1105	7.0626	7.0155
util living area	0.9959	0.9776	0.9046	0.7161	0.5100	0.3473	0.2499	0.2866	0.4905	0.8425	0.9851	0.9975 (86)
MIT	20.3899	20.5890	20.7998	20.9290	20.9537	20.9569	20.9570	20.9571	20.9553	20.8923	20.6102	20.3574 (87)
Th 2	20.2693	20.2719	20.2745	20.2876	20.2902	20.3033	20.3033	20.3059	20.2980	20.2902	20.2850	20.2797 (88)
util rest of house	0.9946	0.9716	0.8844	0.6803	0.4718	0.3096	0.2103	0.2434	0.4412	0.8056	0.9802	0.9967 (89)
MIT 2	19.5487	19.8016	20.0566	20.2073	20.2322	20.2480	20.2481	20.2509	20.2417	20.1769	19.8417	19.5161 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	19.6561	19.9021	20.1515	20.2994	20.3243	20.3385	20.3386	20.3411	20.3328	20.2683	19.9398	19.6235 (91)
Temperature adjustment												0.0000
adjusted MIT	19.6561	19.9021	20.1515	20.2994	20.3243	20.3385	20.3386	20.3411	20.3328	20.2683	19.9398	19.6235 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9933	0.9679	0.8806	0.6809	0.4737	0.3115	0.2123	0.2456	0.4437	0.8044	0.9772	0.9958 (94)
Useful gains	1572.5880	1992.3042	2232.0861	2052.5067	1582.3177	1034.6513	674.1600	707.7943	1131.1253	1655.1614	1593.4348	1455.2173 (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	2914.0941	2836.0265	2570.7913	2105.2891	1586.5078	1034.8058	674.1672	707.8143	1132.9848	1778.5466	2380.6258	2882.0821 (97)
Space heating kWh	998.0806	566.9814	251.9966	38.0033	3.1174	0.0000	0.0000	0.0000	0.0000	91.7986	566.7776	1061.5874 (98a)
Space heating requirement - total per year (kWh/year)												3578.3429
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	998.0806	566.9814	251.9966	38.0033	3.1174	0.0000	0.0000	0.0000	0.0000	91.7986	566.7776	1061.5874 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3578.3429
Space heating per m2										(98c) / (4) =		14.7378 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												
Fraction of space heat from main system(s)												
Efficiency of main space heating system 1 (in %)												
Efficiency of main space heating system 2 (in %)												
Efficiency of secondary/supplementary heating system, %												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	998.0806	566.9814	251.9966	38.0033	3.1174	0.0000	0.0000	0.0000	0.0000	91.7986	566.7776	1061.5874 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	399.3920	226.8833	100.8390	15.2074	1.2475	0.0000	0.0000	0.0000	0.0000	36.7341	226.8017	424.8049 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	341.3064	285.6361	258.7202	188.7890	145.4551	125.8695	121.5163	146.2761	184.8781	250.3862	300.8946	337.2300 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	194.9209	163.1274	147.7557	107.8178	83.0697	71.8844	69.3982	83.5386	105.5843	142.9961	171.8416	192.5928 (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	55.1181	49.7841	55.1181	53.3401	55.1181	53.3401	55.1181	55.1181	53.3401	55.1181	53.3401	55.1181 (231)
Lighting	42.1709	33.8311	30.4611	22.3171	17.2384	14.0839	15.7254	20.4405	26.5502	34.8353	39.3464	43.3430 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-82.1922	-132.2475	-211.6308	-256.4099	-288.3098	-273.5472	-269.6866	-249.3910	-211.4011	-159.6034	-95.4904	-68.9244 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1431.9099 (211)

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Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	175.1000	
Water heating fuel used	1534.5275	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7840)		
mechanical ventilation fans (SFP = 0.7840)	568.9717	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	648.9717	(231)
Electricity for lighting (calculated in Appendix L)	340.3433	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2298.8342	(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	1656.9182	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	859.1460	17.2320	176.4686 (240)
Space heating - main system 1 (low-rate cost)	572.7640	0.1227	70.2781 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (electric off-peak tariff)			
High-rate fraction			0.7000 (243)
Low-rate fraction			0.3000 (244)
High-rate cost	1074.1693	20.5400	220.6344 (245)
Low-rate cost	460.3583	12.2700	56.4860 (246)
Energy for instantaneous electric shower(s)	0.0000	18.8860	0.0000 (247a)
Pumps, fans and electric keep-hot (0.80*20.54 + 0.20*12.27)	568.9717	18.8860	97.1041 (249)
Pump for solar water heating	80.0000	18.8860	15.1088 (249)
Energy for lighting (0.80*20.54 + 0.20*12.27)	340.3433	18.8860	64.2772 (250)
Additional standing charges			21.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2298.8342	18.8860	-434.1578
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-434.1578 (252)
Total energy cost			287.1994 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.3592 (257)
SAP value		94.1766
SAP rating (Section 12)		94 (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 (high-rate cost)	859.1460	0.1641	140.9491 (261)
Space heating - main system 1 (low-rate cost)	572.7640	0.1514	86.7447 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	1074.1693	0.1496	160.7370 (264)
Water heating - low rate cost	460.3583	0.1381	63.5716 (264)
Space and water heating			452.0024 (265)
Pumps, fans and electric keep-hot	648.9717	0.1412	90.2234 (267)
Energy for lighting	340.3433	0.1468	49.9765 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2298.8342	0.1353	-311.0310
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-311.0310 (269)
Total CO2, kg/year			281.1712 (272)
CO2 emissions per m2			1.1600 (273)
EI value			98.6909
EI rating			99 (274)
EI band			A

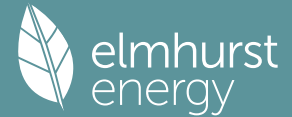
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	121.4000 (1b)	x 2.4000 (2b)	= 291.3600 (1b) - (3b)
First floor	121.4000 (1c)	x 2.5000 (2c)	= 303.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	242.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	594.8600 (5)



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Water storage loss:	43.3124	38.1496	40.1101	34.2314	32.4869	28.5130	27.5732	29.0847	29.8673	34.2176	37.5049	42.7009 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9450 (55)
Total storage loss	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (56)
If cylinder contains dedicated solar storage	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	341.3064	301.8021	318.5621	272.3176	256.3425	228.3418	223.3519	234.3587	244.5745	279.2788	300.8946	337.2300 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												732.5549 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												732.5549
Solar input	-5.9077	-22.8495	-68.0212	-94.6661	-114.2395	-114.1942	-99.4078	-96.8326	-70.2903	-37.7251	-8.4209	-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	335.3987	278.9526	250.5409	177.6515	142.1030	114.1476	123.9441	137.5261	174.2841	241.5537	292.4736	337.2300 (64)
												Total per year (kWh/year) = Sum(64)m = 2605.8061 (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	138.0550	122.5420	129.8400	111.1663	103.8231	93.8080	92.7450	96.8397	102.5732	116.7783	123.8254	136.6996 (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	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542	183.4542 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.1791	42.7923	34.8010	26.3466	19.6944	16.6268	17.9659	23.3527	31.3440	39.7984	46.4506	49.5182 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	612.0873	618.4388	602.4331	568.3589	525.3462	484.9205	457.9135	451.5620	467.5677	501.6419	544.6545	585.0803 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030	56.4030 (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)	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028	-122.3028 (71)
Water heating gains (Table 5)	185.5578	182.3541	174.5161	154.3976	139.5472	130.2889	124.6573	130.1610	142.4627	156.9601	171.9798	183.7360 (72)
Total internal gains	966.3785	964.1396	932.3046	869.6575	805.1422	749.3906	718.0911	722.6301	758.9288	818.9548	883.6393	938.8889 (73)

## 6. Solar gains

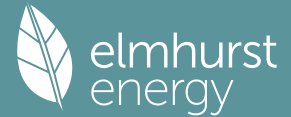
[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W						
Northeast	6.0700	15.4538	0.7200	0.7000	0.7700	32.7633 (75)						
Southeast	30.3100	47.2368	0.7200	0.7000	0.7700	500.0694 (77)						
Northwest	2.8800	15.4538	0.7200	0.7000	0.7700	15.5450 (81)						
Southeast	9.1200	52.7967	0.7200	0.7000	1.0000	218.4112 (82)						
Northwest	3.6000	22.4937	0.7200	0.7000	1.0000	36.7314 (82)						
Solar gains	803.5203	1187.3394	1706.5560	2344.1459	2604.1752	2839.7188	2430.0840	2333.6712	1975.3021	1352.8227	916.6790	701.6404 (83)
Total gains	1769.8988	2151.4790	2638.8606	3213.8033	3409.3174	3589.1094	3148.1751	3056.3013	2734.2309	2171.7774	1800.3183	1640.5293 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	86.5328	87.5114	87.5114	89.1926	89.5366	91.6577	91.2972	92.0210	90.9396	88.8512	88.5124	86.8566
alpha	6.7689	6.8341	6.8341	6.9462	6.9691	7.1105	7.0865	7.1347	7.0626	6.9234	6.9008	6.7904
util living area	0.9891	0.9657	0.8817	0.6958	0.5272	0.3586	0.3109	0.3177	0.4800	0.7969	0.9645	0.9920 (86)
MIT	20.4984	20.6463	20.8232	20.9304	20.9517	20.9561	20.9561	20.9563	20.9546	20.9093	20.7060	20.4793 (87)
Th 2	20.2511	20.2589	20.2589	20.2719	20.2745	20.2902	20.2876	20.2928	20.2850	20.2693	20.2667	20.2537 (88)
util rest of house	0.9858	0.9565	0.8578	0.6599	0.4884	0.3223	0.2691	0.2753	0.4323	0.7534	0.9530	0.9894 (89)
MIT 2	19.6710	19.8611	20.0683	20.1926	20.2146	20.2340	20.2312	20.2368	20.2276	20.1731	19.9436	19.6494 (90)
Living area fraction										fLA = Living area / (4) = 0.1277 (91)		
MIT	19.7766	19.9613	20.1647	20.2868	20.3087	20.3261	20.3238	20.3287	20.3204	20.2671	20.0409	19.7553 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7766	19.9613	20.1647	20.2868	20.3087	20.3261	20.3238	20.3287	20.3204	20.2671	20.0409	19.7553 (93)

## 8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9831	0.9522	0.8544	0.6606	0.4903	0.3242	0.2712	0.2775	0.4347	0.7533	0.9488	0.9872	(94)
Useful gains	1739.9309	2048.6188	2254.7643	2123.0937	1671.5372	1163.4803	853.8772	848.0574	1188.5213	1635.9659	1708.1119	1619.4564	(95)
Ext temp.	5.4000	5.7000	7.0000	8.8000	11.4000	14.0000	15.7000	15.7000	13.9000	11.2000	8.2000	5.7000	(96)
Heat loss rate W	2801.3182	2747.7764	2536.4806	2171.4859	1677.6433	1163.7419	853.9373	848.1228	1190.4155	1720.6413	2255.6296	2728.5064	(97)
Space heating kWh	789.6721	469.8339	209.5969	34.8424	4.5430	0.0000	0.0000	0.0000	0.0000	62.9985	394.2127	825.1332	(98a)
Space heating requirement - total per year (kWh/year)												2790.8327	
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	789.6721	469.8339	209.5969	34.8424	4.5430	0.0000	0.0000	0.0000	0.0000	62.9985	394.2127	825.1332	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2790.8327	
Space heating per m2										(98c) / (4) =		11.4944	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													249.9000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	789.6721	469.8339	209.5969	34.8424	4.5430	0.0000	0.0000	0.0000	0.0000	62.9985	394.2127	825.1332	(98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)	
Space heating fuel (main heating system)	315.9952	188.0088	83.8723	13.9426	1.8179	0.0000	0.0000	0.0000	0.0000	25.2095	157.7482	330.1854	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	335.3987	278.9526	250.5409	177.6515	142.1030	114.1476	123.9441	137.5261	174.2841	241.5537	292.4736	337.2300	(64)	
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)	
Fuel for water heating, kWh/month	191.5470	159.3104	143.0845	101.4572	81.1554	65.1899	70.7848	78.5415	99.5341	137.9519	167.0323	192.5928	(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	55.1181	49.7841	55.1181	53.3401	55.1181	53.3401	55.1181	55.1181	53.3401	55.1181	53.3401	55.1181	(231)	
Lighting	42.1709	33.8311	30.4611	22.3171	17.2384	14.0839	15.7254	20.4405	26.5502	34.8353	39.3464	43.3430	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-107.2431	-144.5522	-224.9901	-273.5315	-293.5143	-287.7306	-268.7331	-261.9476	-228.2492	-174.1341	-116.9085	-92.8138	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													1116.7798	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													1488.1817	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7840)														
mechanical ventilation fans (SFP = 0.7840)													568.9717	(230a)
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													648.9717	(231)
Electricity for lighting (calculated in Appendix L)													340.3433	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2474.3480	(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													1119.9284	(238)

## 10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	670.0679	29.3660	248.6622	(240)
Space heating - main system 1 (low-rate cost)	446.7119	0.1775	79.2914	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1041.7272	37.1100	386.5850	(245)
Low-rate cost	446.4545	17.7500	79.2457	(246)
Energy for instantaneous electric shower(s)	0.0000	33.2380	0.0000	(247a)

# Full SAP Calculation Printout



Pumps, fans and electric keep-hot (0.80*37.11 + 0.20*17.75)	568.9717	33.2380	164.8812 (249)
Pump for solar water heating	80.0000	33.2380	26.5904 (249)
Energy for lighting (0.80*37.11 + 0.20*17.75)	340.3433	33.2380	113.1233 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2474.3480	33.2380	-822.4238
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-822.4238 (252)
Total energy cost			367.9553 (255)

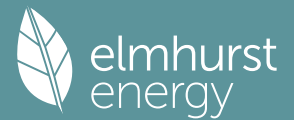
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1 (high-rate cost)	670.0679	0.1642	110.0337 (261)
Space heating - main system 1 (low-rate cost)	446.7119	0.1516	67.7203 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	1041.7272	0.1499	156.1064 (264)
Water heating - low rate cost	446.4545	0.1383	61.7409 (264)
Space and water heating			395.6012 (265)
Pumps, fans and electric keep-hot	648.9717	0.1412	90.2234 (267)
Energy for lighting	340.3433	0.1468	49.9765 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2474.3480	0.1361	-336.8618
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-336.8618 (269)
Total CO2, kg/year			198.9393 (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 (high-rate cost)	670.0679	0.9668	1079.6579 (275)
Space heating - main system 1 (low-rate cost)	446.7119	1.5577	695.8535 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating - high rate cost	1041.7272	1.5580	1623.0590 (278)
Water heating - low rate cost	446.4545	1.5062	672.4532 (278)
Space and water heating			4071.0236 (279)
Pumps, fans and electric keep-hot	648.9717	1.5239	982.5842 (281)
Energy for lighting	340.3433	1.5451	525.8552 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2474.3480	1.5052	-3724.3585
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-3724.3585 (283)
Total Primary energy kWh/year			1855.1045 (286)

# Predicted Energy Assessment



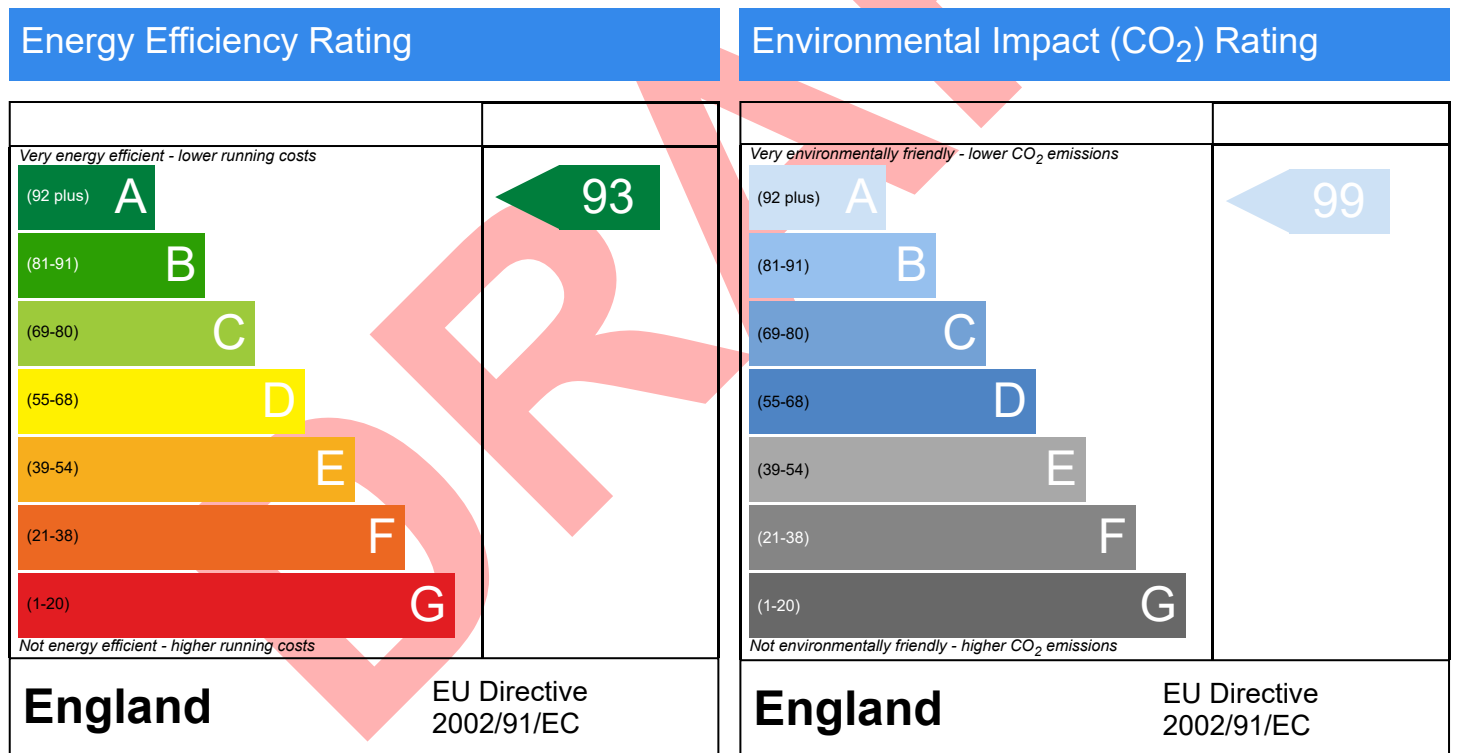
New Dwelling, Land East of Lower Town Barn,  
Trewidland, Cornwall, PL14 4ST

Dwelling type:  
Date of assessment:  
Produced by:  
Total floor area:  
DRRN:

House, Detached  
30/11/2023  
Warren Mazgaj  
242.8 m<sup>2</sup>

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

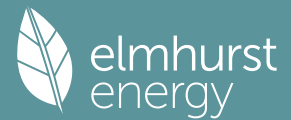
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

# Summary for Input Data



Property Reference	23-S936	Issued on Date	30/11/2023
Assessment Reference	23-S936	Prop Type Ref	
Property	New Dwelling, Land East of Lower Town Barn, Trewidland, Cornwall, PL14 4ST		

SAP Rating	93 A	DER	1.36	TER	6.79
Environmental	99 A	% DER < TER			79.97
CO <sub>2</sub> Emissions (t/year)	0.24	DFEE	30.88	TFEE	35.81
Compliance Check	See BREL	% DFEE < TFEE			13.77
% DPER < TPER	62.48	DPER	13.43	TPER	35.78

Assessor Details	Mr. Warren Mazgaj	Assessor ID	B581-0001
Client	HORSLEY01, MAH Building Serviced Ltd		

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

Orientation	Northwest
Property Tenure	ND
Transaction Type	6
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2023
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Enter TMP value
Thermal Mass	250.00 kJ/m <sup>2</sup> K
7.0 Electricity Tariff	10 Hour Off Peak
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground floor:	49.10 m	121.40 m <sup>2</sup>	2.40 m
	1st Storey:	49.10 m	121.40 m <sup>2</sup>	2.50 m

8.0 Living Area	31.00 m <sup>2</sup>
-----------------	----------------------

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Res	Shelter	Openings	Area Calculation Type
Wall	Cavity Wall	Cavity wall : dense plaster, AAC block, filled cavity, any outside structure	0.17		175.73	134.07	0.00	None	41.66	Enter Gross Area

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Code	Shelter Factor	Calculation Type	Openings
Roof	External Slope Roof	Plasterboard, insulated slope	0.08	9.00	172.66	159.94	None	0.00	Enter Gross Area	12.72

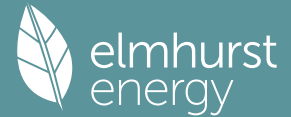
Description	Type	Storey Index	Construction	U-Value (W/m <sup>2</sup> K)	Shelter Code	Shelter Factor	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Floor	Ground Floor - Solid	Lowest occupied	Slab on ground, screed over insulation	0.09	None	0.00	110.00	121.40

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
Window	Manufacturer	Window	Double Low-E Hard 0.2			0.72		0.70	1.20
Door	Manufacturer	Half Glazed Door	Double Low-E Hard 0.2			0.72		0.70	1.40
Rooflight	Manufacturer	Roof Window	Double Low-E Hard 0.2			0.72		0.70	1.20

Name	Opening Type	Location	Orientation	Area (m <sup>2</sup> )	Pitch
NW Door	Door	Wall	North West	2.40	
NW Windows	Window	Wall	North West	2.88	
NW Rooflight	Rooflight	Roof	North West	3.60	45
SE Windows	Window	Wall	South East	30.31	

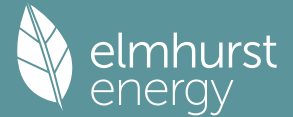


# Summary for Input Data



SE Rooflight NE Window	Rooflight Window	Roof Wall	South East North East	9.12 6.07	45
<b>14.0 Conservatory</b>		<input type="text" value="None"/>			
<b>15.0 Draught Proofing</b>		<input type="text" value="100"/> %			
<b>16.0 Draught Lobby</b>		<input type="text" value="No"/>			
<b>17.0 Thermal Bridging</b>		<input type="text" value="Calculate Bridges"/>			
<b>17.1 List of Bridges</b>					
Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E2 Other lintels (including other steel lintels)	Non Gov Approved Schemes	19.96	0.58	0.58 UI-CWP-E2-WDC-03 V1	Yes
E3 Sill	Non Gov Approved Schemes	5.20	0.02	0.02 UI-CWP-E3-WDC-CON-04	No
E4 Jamb	Non Gov Approved Schemes	31.20	0.00	0.00 UI-CWP-E4-WD-06 V1	No
E5 Ground floor (normal)	Non Gov Approved Schemes	49.10	0.05	0.05 UI-CWP-E5-GF-01 V1	Yes
E6 Intermediate floor within a dwelling	Non Gov Approved Schemes	49.10	0.00	0.00 UI-CWP-E6-IF-02 V1	Yes
E16 Corner (normal)	Non Gov Approved Schemes	12.40	0.04	0.04 UI-CWP-E16-EXT-CRN V1	No
R1 Head of roof window	Non Gov Approved Schemes	7.40	0.06	0.06 UI-GEN-R1-Head-01 V1	Yes
R2 Sill of roof window	Non Gov Approved Schemes	4.20	0.06	0.06 UI-GEN-R2-Sill-01 V1	No
R3 Jamb of roof window	Non Gov Approved Schemes	36.00	0.06	0.06 UI-GEN-R3-Jamb-01 V1	Yes
E11 Eaves (insulation at rafter level)	Non Gov Approved Schemes	35.60	0.05	0.05 UI-CWP-E11-RF-03 V1	No
E13 Gable (insulation at rafter level)	Non Gov Approved Schemes	19.40	0.04	0.04 UI-CWP-E13-RG-03 V1	No
R4 Ridge (vaulted ceiling)	Table K1 - Default	17.80	0.12	0.12	No
Y-value	<input type="text" value="0.05"/> W/m <sup>2</sup> K				
<b>18.0 Pressure Testing</b>		<input type="text" value="Yes"/>			
Designed AP <sub>50</sub>	<input type="text" value="3.20"/> m <sup>3</sup> /(h.m <sup>2</sup> ) @ 50 Pa				
Test Method	<input type="text" value="Blower Door"/>				
<b>19.0 Mechanical Ventilation</b>					
Mechanical Ventilation					
Mechanical Ventilation System Present	<input type="text" value="Yes"/>				
Approved Installation	<input type="text" value="No"/>				
Mechanical Ventilation data Type	<input type="text" value="Database"/>				
Type	<input type="text" value="Balanced mechanical ventilation with heat recovery"/>				
MV Reference Number	<input type="text" value="500530"/>				
Configuration	<input type="text" value="4"/>				
Manufacturer SFP	<input type="text" value="0.56"/>				
Duct Type	<input type="text" value="Rigid"/>				
MVHR Efficiency	<input type="text" value="87.00"/>				
Wet Rooms	<input type="text" value="4"/>				
SFP from Installer Commissioning Certificate	<input type="text" value="No"/>				
MVHR System Location	<input type="text" value="Inside heated envelope (installed exclusively)"/>				
Duct Installation Specification	<input type="text" value="Level 1"/>				
<b>20.0 Fans, Open Fireplaces, Flues</b>					
<b>21.0 Fixed Cooling System</b>		<input type="text" value="No"/>			
<b>22.0 Lighting</b>					
No Fixed Lighting	<input type="text" value="No"/>				
Name Lighting	Efficacy	Power	Capacity	Count	
	99.00	12	1188	20	
<b>24.0 Main Heating 1</b>		<input type="text" value="SAP table"/>			
Description	<input type="text" value="224/2207/901"/>				
Percentage of Heat	<input type="text" value="100.00"/> %				
Fuel Type	<input type="text" value="Electricity"/>				
SAP Code	<input type="text" value="214"/>				
In Winter	<input type="text" value="249.90"/>				
In Summer	<input type="text" value="175.10"/>				
Controls SAP Code	<input type="text" value="2207"/>				
Is MHS Pumped	<input type="text" value="Pump in heated space"/>				

# Summary for Input Data



Heating Pump Age	2013 or later
Heat Emitter	Radiators and Underfloor
Underfloor Heating	Yes - Pipes in thin screed
Flow Temperature	Enter value
Flow Temperature Value	35.00

**25.0 Main Heating 2**

**26.0 Heat Networks**

Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power Ratio	Electrical	Fuel Factor	Efficiency type
Heat source 1									
Heat source 2									
Heat source 3									
Heat source 4									
Heat source 5									

**28.0 Water Heating**

Water Heating	Main Heating 1
SAP Code	901
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
Cold Water Source	From mains
Bath Count	1
Supplementary Immersion	No
Immersion Only Heating Hot Water	No

**28.1 Showers**

Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To
-------------	-------------	-------------------	------------------	-----------	--------------

**28.3 Waste Water Heat Recovery System**

**29.0 Hot Water Cylinder**

Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	1.75	kWh/day
Pipes insulation	Fully insulated primary pipework	
In Airing Cupboard	No	

**31.0 Thermal Store**

**32.0 Photovoltaic Unit**

One Dwelling	One Dwelling
Export Capable Meter?	No
Connected To Dwelling	Yes
Diverter	No
Battery Capacity [kWh]	4.00

PV Cells kWp	Orientation	Elevation	Overshading	FGHRS	MCS Certificate	Overshading Factor	MCS Certificate Reference	Panel Manufacturer
4.00	South West	30°			Yes	1.00		

# Summary for Input Data



## 34.0 Small-scale Hydro

None

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

### Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

**Typical Cost**  
£4,000 - £6,000

**Typical savings per year**  
£100

**Ratings after improvement**  
**SAP rating**      **Environmental Impact**  
 A 94                      A 99  
 0                              0  
 0                              0

# Thermal Bridging

Property Reference	23-S936	Issued on Date	30/11/2023
Assessment Reference	23-S936	Prop Type Ref	Detached House
Property	New Dwelling, Land East of Lower Town Barn, Trewidland, Cornwall, PL14 4ST		

SAP Rating	93 A	DER	1.36	TER	6.79
Environmental	99 A	% DER < TER			79.97
CO <sub>2</sub> Emissions (t/year)	0.24	DFEE	30.88	TFEE	35.81
Compliance Check	See BREL	% DFEE < TFEE			13.77
% DPER < TPER	62.48	DPER	13.43	TPER	35.78

Assessor Details	Mr. Warren Mazgaj	Assessor ID	B581-0001
Client	HORSLEY01, MAH Building Serviced Ltd		

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Non Gov Approved Schemes	0.580	19.96	11.58	UI-CWP-E2-WDC-03 V1
External wall	E3 Sill	Non Gov Approved Schemes	0.016	5.20	0.08	UI-CWP-E3-WDC-CON-04
External wall	E4 Jamb	Non Gov Approved Schemes	0.001	31.20	0.03	UI-CWP-E4-WD-06 V1
External wall	E5 Ground floor (normal)	Non Gov Approved Schemes	0.052	49.10	2.55	UI-CWP-E5-GF-01 V1
External wall	E6 Intermediate floor within a dwelling	Non Gov Approved Schemes	0.001	49.10	0.05	UI-CWP-E6-IF-02 V1
External wall	E16 Corner (normal)	Non Gov Approved Schemes	0.037	12.40	0.46	UI-CWP-E16-EXT-CRN V1
External roof	R1 Head of roof window	Non Gov Approved Schemes	0.061	7.40	0.45	UI-GEN-R1-Head-01 V1
External roof	R2 Sill of roof window	Non Gov Approved Schemes	0.060	4.20	0.25	UI-GEN-R2-Sill-01 V1
External roof	R3 Jamb of roof window	Non Gov Approved Schemes	0.056	36.00	2.02	UI-GEN-R3-Jamb-01 V1
External wall	E11 Eaves (insulation at rafter level)	Non Gov Approved Schemes	0.048	35.60	1.71	UI-CWP-E11-RF-03 V1
External wall	E13 Gable (insulation at rafter level)	Non Gov Approved Schemes	0.037	19.40	0.72	UI-CWP-E13-RG-03 V1
External roof	R4 Ridge (vaulted ceiling)	Table K1 - Default	0.120	17.80	2.14	

Total: 287.36 W/mK:  
 Y-Value: 0.05 W/m²K:

# Overview Report

Dwelling Address	New Dwelling, Land East of Lower Town Barn, Trewidland, Cornwall, PL14 4ST
Report Date	30/11/2023
Property Type	House, Detached
Floor Area [m <sup>2</sup> ]	243

This document is not an Energy Performance Certificate (EPC) as required by the Energy Performance of Buildings Regulations

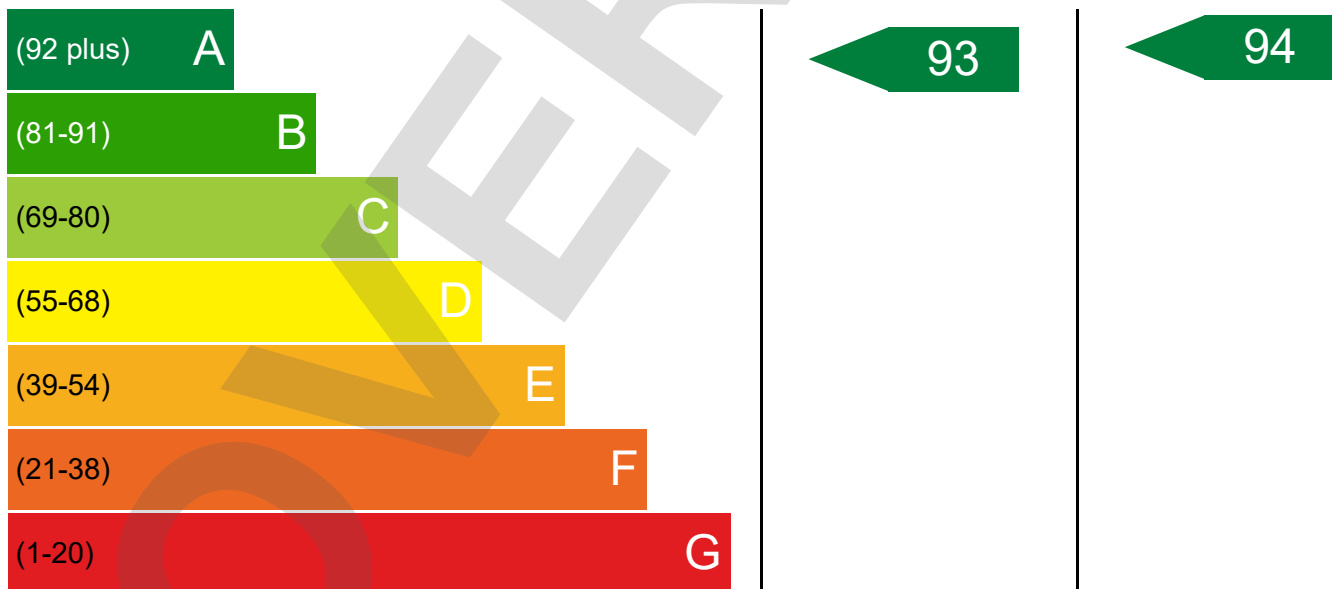
## Energy Rating

The current energy rating represents the overall energy efficiency of the dwelling. The potential energy rating is the overall energy rating of the dwelling after all of the recommend measures provided on the next page have been installed. A higher score represents a more energy efficient dwelling with lower fuel bills.

Most energy efficient - lower running costs

CURRENT

POTENTIAL



Least energy efficient - higher running costs

## Breakdown of property's energy performance

Each feature is assessed as one of the following:



Feature	Description	Energy Performance
Walls	Average thermal transmittance 0.17 W/m <sup>2</sup> K	Very Good
Roof	Average thermal transmittance 0.08 W/m <sup>2</sup> K	Very Good
Floor	Average thermal transmittance 0.09 W/m <sup>2</sup> K	Very Good
Windows	High performance glazing	Very Good
Main heating	Air source heat pump, radiators and underfloor, electric	Average
Main heating controls	Time and temperature zone control	Very Good
Secondary heating	None	
Hot water	From main system	Poor
Lighting	Excellent lighting efficiency	Very Good
Air tightness	Air permeability [AP50] = 3.2 m <sup>3</sup> /h.m <sup>2</sup> (assumed)	Good

## Primary Energy use

The primary energy use for this property per year is 10 kilowatt hour (kWh) per square metre

## Estimated CO<sub>2</sub> emissions of the dwelling





The estimated CO rating provides an indication of the dwelling's impact on the environment in terms of carbon dioxide emissions; the higher the rating the less impact it has on the environment.

The estimated CO emissions for this dwellings is: **0.2** per year

With the recommended measures the potential CO emissions could be: **0.0** per year

## Recommendations

The recommended measures provided below will help to improve the energy efficiency of the dwelling. To reach the dwelling's potential energy rating all of the recommended measures shown below would need to be installed. Having these measures installed individually or in any other order may give a different result when compared with the cumulative potential rating.

Recommended measure	Typical Yearly Saving	Potential Rating after measure installed	Cumulative savings (per year)	Cumulative Potential Rating
Solar water heating	£100	 1	£100	 A 94
Photovoltaic		 -94	£468	 G 0

## Estimated energy use and potential savings

Estimated energy cost for this property over a year

**£468**

Over a year you could save

**£100**

The estimated cost and savings show how much the average household would spend in this property for heating, lighting and hot water. It is not based on how energy is used by the people living at the property.

## Contacting the assessor and the accreditation scheme

## Assessor contact details

Assessor name	Mr. Warren Mazgaj
Assessor's accreditation number	
Email Address	

## Accreditation scheme contact details

Accreditation scheme	
Telephone	
Email Address	

## Assessment details

Related party disclosure	
Date of assessment	28/07/2023
Date of certificate	28/07/2023
Type of assessment	SAP, new dwelling