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Climate Emergency Development Plan Document Planning Policy SEC1	Date:	Dec 2023
	Ref:	234
Description:	Construction of a new dwelling	
Location:	Wheal Down House, Marazion, Penzance TR20 9NY	

Planning Policy SEC1 Energy Statement for a new dwelling



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OCDEA - Accredited SAP Assessor

This document is to be read in conjunction with associated drawings and information as submitted with a Planning Permission application

EAC South West 'Providing advice to maximise energy efficiency and reduce property running costs'
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Planning Policy SEC1 Energy Statement for a new dwelling

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- ✓ Climate Emergency DPD Policy SEC 1 part 2b Energy Summary Tool (SAP)



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1 EXECUTIVE SUMMARY

This energy statement has been prepared to support a Full Planning application for the construction of a New Dwelling at Wheal Down House, Marazion TR20 9NY.

This energy statement is used to demonstrate how the property has been designed to prioritise a low energy and sustainable living environment through the inclusion of;

- ✓ highly insulated external elements
- ✓ energy efficient space heating
- ✓ the use of low and zero carbon energy systems

which will have a positive impact on the local environment and meet the technical requirements of Cornwall Council Planning Policy SEC1

Note: figures used in this statement derive from calculations produced by SAP 10 modelling software.

2 INTRODUCTION

EAC South West is an established 'On-Construction SAP / EPC' energy assessment and building regulation compliance consultancy has been instructed to provide this report to assist relevant parties in understanding the design concept for the buildings energy consumption and performance.

A SAP calculation can only be prepared by an accredited OCDEA SAP Assessor. EAC South West holds this qualification and has used Elmhurst Energy Assessment software in the preparation of this energy statement.

The Energy Strategy for this development has taken into account Lean, Clean and Green factors to minimise energy demand, by adopting;

- ✓ Be Lean: use less energy and optimise the most suitable passive measures
- ✓ Be Clean: use of the most suitable energy efficient heating system
- ✓ Be Green: measures for carbon emission savings

To show compliance with Policy SEC1, the report is based on results obtained with use of the Governments Standard Assessment Procedure (SAP) which is used for calculating the energy performance of dwellings and CO₂ emissions.



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3 PLANNING POLICY

Energy statements are a mandatory requirement for applications relating to a new build home (not for homes formed by a change of use).

Cornwall Council Climate Emergency Development Plan Document Planning Policy SEC1 Sustainable Energy and Construction Part 2b focuses on the energy use of new build homes in a drive towards net zero operational energy demand through three elements of policy.

1. Space heating energy threshold: 30kWh/m²/year
2. Total energy threshold: 40kWh/m²/year
3. Renewable Energy Requirement +> than the total energy demand

The council's Planning Policy SEC1: Energy Summary Tool – sap v2 is used to summarise results.

4 THE DESIGN

A SAP 10 calculation has been used to model the dwelling and the data produced has been used to show compliance with Planning Policy SEC1, and the Building Regulations Part L.

The design: includes measures that will minimise energy consumption, reduce CO₂ emissions below that of the Building Regulation Target Emission Rate (TER) and also incorporate low and zero carbon energy generation to ensure that the property meets the energy efficiency demands of Planning Policy SEC1 and the technical requirements of the Building Regulations Part L.

Construction elements: the proposed development has included improved insulation standards, exceeding the Building Regulation: Part L requirements to retain heat and maximise thermal comfort in living spaces and ensure a good quality of life for occupants.

Element	Measure	Proposed	Part L
Ground Floor	W/m ² K	0.1	0.18
External Wall	W/m ² K	0.1	0.18
Roof	W/m ² K	0.1	0.15
Openings	W/m ² K	0.8	1.40



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Solar Gains: the design and orientation enables the property to benefit from solar gains, which make a significant contribution towards energy efficiency and reducing energy requirements during winter months.

Building Regulations Part O: an overheating assessment of the dwelling has been completed and confirms that the design complies with Part O guidance for glazing, openings and natural ventilation requirements.

Energy Efficient Measures

Lighting: low energy lighting (LED) shall be fitted throughout the property.

Heating and Hot Water: the property will use a ground source heat pump to collect low temperature heat from the ground, and to then concentrate that heat to a usable temperature for space heating and hot water.

Although the heat pump will use electricity to run the pumps, the energy coefficient of performance is generally 3 'or more', meaning that for every 1kWh of electricity used, 3kWh 'or more' of heat is generated.

Element	Measure	Proposed	Part L
Space Heating Emitter	Part L 2022	Proposed flow temp 35c	Max flow temp 55c
Heating Controls	Part L 2022	Time and temperature zone control	Time and temperature zone control
Mechanical ventilation with heat recovery	Part L 2022: SFP 'Specific Fan Power'	SFP 0.5 and heat recovery 81%	SFP 1.5 and heat recovery 73%

The heating system will be run in tandem with a Mechanical Ventilation and Heat Recovery System to ensure that heat retention is maximised, and that energy input will be minimal.



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5 LOW AND ZERO CARBON ENERGY SYSTEMS

The design has significantly reduced energy use and carbon emissions through enhanced fabric and energy efficient measures, and it is proposed to make the property more efficient with the inclusion of a ground source heat pump to serve heating and hotwater requirements.

Renewable Energy Systems: an assessment of the options available to reduce CO₂ emissions, and it is proposed for a heat pump to be installed that will serve the heating and hot water demand of the property.

Ground Source Heat Pump: has been included in the design. The low carbon green energy heating system will provide enough power for the space heating and hot water demands of the dwelling

Solar Photovoltaics (PV): the proposals include a PV installation.

The PV system is expected to achieve 6054 kWh/year and an additional benefit of PV is that any surplus energy generated will be available for export to the national grid, and therefore further reducing the development carbon footprint.

Ventilation: the need to provide additional ventilation through a mechanical ventilation with heat recovery (MVHR) will be installed to provide a constant supply of fresh filtered air, whilst heat is recovered and circulated back into the property.

Building Regulations Part G 17k. Water Efficiency: the potential consumption of wholesome water by persons occupying a dwelling should not exceed 125 litres per person per day.

A water efficiency calculation has been carried out in accordance with the methodology set out in Part G and confirms that the design complies with water efficiency requirements.



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6 RESULTS

Planning Policy SEC1: Energy Summary Tool – output summary

Note: figures used in this statement derive from calculations produced by SAP 10 modelling software.

Results			
Space heat demand	Total energy use	Renewable generation	Renewable deficit
kWh/m ² _{TFA} .yr	kWh/m ² _{GIA} .yr	% total energy	kWh/year
Required values:			
<30	<40	100%	0
<i>30.0</i>	<i>33.4</i>	<i>107%</i>	<i>0</i>
27.4	17.0	107%	0

Planning Policy SEC1	Space Heating Demand kWh/m ² /yr	Total Energy Use kWh/m ² /yr	Renewable Energy Generation % total energy
Proposed Dwelling	27.4	17.0	107%
Compliance	Max 30	Max 40	(17.0 / 100) x 107% = 18.19
	PASS	PASS	PASS

Note: No offsetting payment is due with this scheme.

Building Regulations Compliance – Part L 2021

Building Regulations Part L 2021	Dwelling Emission Rate kgCO ₂ /m ²
Dwelling Target Emission Rate	9.6
Dwelling 'As-Designed' Emission Rate	0.15
Part L PASS	+ 96.77%
Building Regulations Part L 2021	Fabric Energy Efficiency kWh/m ² /yr
Dwelling Target Fabric Energy Efficiency	53.92
Dwelling 'As-Designed' Fabric Energy Efficiency	42.86
PART L PASS	+ 20.51%
SAP RATING	98A



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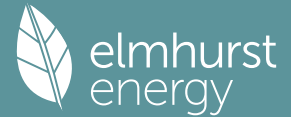
7 CONCLUSION

- There appears to be no technical problems with the design proposals
- The development accords with the guidance set out in the [Cornwall Council Planning Policy SEC1 Sustainable Energy and Construction Part 2b](#)
- The design is compliant with relevant building Regulation requirements
 - Part G 17k. water efficiency
 - Part L. conservation of fuel and power
 - Part O. overheating
- The design acknowledges the constraints and opportunities provided by the site and location
- No offsetting payment is necessary with this scheme

8 APPENDICES

- ✓ **SAP Calculation**

Full SAP Calculation Printout



Property Reference	234		Issued on Date	05/12/2023	
Assessment Reference	New Build Dwelling	Prop Type Ref	New Build		
Property	Wheal Down House, ., Trenow Lane, Marazion, Cornwall, TR20 9NY				
SAP Rating	98 A	DER	0.31	TER	9.60
Environmental	100 A	% DER < TER			96.77
CO ₂ Emissions (t/year)	-0.15	DFEE	42.86	TFEE	53.92
Compliance Check	See BREL	% DFEE < TFEE			20.51
% DPER < TPER	89.22	DPER	5.57	TPER	51.68
Assessor Details	Mr. Jeremy Downing			Assessor ID	M928-0001
Client	234, Philip Keller				

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1164.7920 (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	1 * 10 =											10.0000 (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) =	10.0000 / (5) =											0.0086 (8)
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50												1.0000 (17)
Infiltration rate												0.0586 (18)
Number of sides sheltered												0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.0586 (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	0.0747	0.0732	0.0718	0.0644	0.0630	0.0557	0.0557	0.0542	0.0586	0.0630	0.0659	0.0688 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1697	0.1682	0.1668	0.1594	0.1580	0.1507	0.1507	0.1492	0.1536	0.1580	0.1609	0.1638 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194		(27)
Opening Type 3			5.6600	1.0000	5.6600		(26a)
Dining			1.5000	0.9615	1.4423		(27a)
Lounge			1.5000	0.9615	1.4423		(27a)
Stair			1.5000	0.9615	1.4423		(27a)
Heatloss Floor 1			187.7400	0.0800	15.0192	110.0000	20651.4000 (28a)
External Wall 1	427.0200	82.4400	344.5800	0.0900	31.0122	9.0000	3101.2200 (29a)
External Roof 1	245.2300	4.5000	240.7300	0.1000	24.0730	9.0000	2166.5700 (30)
External Roof 2	22.4400		22.4400	0.1000	2.2440	9.0000	201.9600 (30)
External Roof 3	43.4500		43.4500	0.1000	4.3450	9.0000	391.0500 (30)
Total net area of external elements Aum(A, m ²)			925.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		146.1997		(33)
Internal Wall 1			100.0000			75.0000	7500.0000 (32c)
Internal Wall 2			145.0000			9.0000	1305.0000 (32c)

Full SAP Calculation Printout

Internal Floor 1	165.3000	18.0000	2975.4000 (32d)
Internal Ceiling 1	169.1700	9.0000	1522.5300 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K (28)...(30) + (32) + (32a)...(32e) = 39815.1300 (34)
List of Thermal Bridges 112.7780 (35)

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	48.5500	0.0700	3.3985
E3 Sill	37.0000	0.0400	1.4800
E4 Jamb	111.1000	0.0600	6.6660
R1 Head of roof window	3.6000	0.2400	0.8640
R2 Sill of roof window	3.6000	0.2400	0.8640
R3 Jamb of roof window	7.8000	0.2400	1.8720
E5 Ground floor (normal)	73.2500	0.0400	2.9300
E6 Intermediate floor within a dwelling	58.7500	0.0700	4.1125
E14 Flat roof	13.4000	0.1600	2.1440
E16 Corner (normal)	53.3200	0.1800	9.5976
E17 Corner (inverted - internal area greater than external area)	28.8400	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	54.2500	0.0400	2.1700
E11 Eaves (insulation at rafter level)	31.3500	0.1500	4.7025
E13 Gable (insulation at rafter level)	22.5000	0.2500	5.6250
R4 Ridge (vaulted ceiling)	22.8000	0.1200	2.7360

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 49.1621 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 195.3618 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
65.2280	64.6651	64.1021	61.2872	60.7242	57.9093	57.9093	57.3464	59.0353	60.7242	61.8502	62.9761 (38)

Average = Sum(39)m / 12 =

260.5898	260.0269	259.4639	256.6490	256.0860	253.2711	253.2711	252.7082	254.3971	256.0860	257.2120	258.3379 (39)
256.5083											

HLP (average) Days in mont

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.7381	0.7365	0.7349	0.7270	0.7254	0.7174	0.7174	0.7158	0.7206	0.7254	0.7286	0.7318 (40)
31	28	31	30	31	30	31	31	30	31	30	31
0.7266											

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.2009 (42)
Hot water usage for mixer showers												
Hot water usage for baths												
Hot water usage for other uses												
Average daily hot water use (litres/day)												146.0794 (43)

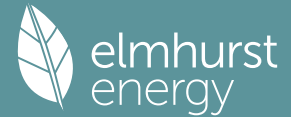
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	158.9161	155.5223	151.3896	145.1058	140.0027	134.5166	132.4086	136.5235	140.8632	146.6227	153.0033	158.5040 (44)
Energy conte	251.6843	221.4617	232.6801	198.6425	188.4705	165.4038	160.1367	169.0446	173.6985	198.9656	217.9813	248.1790 (45)
Energy content (annual)												Total = Sum(45)m = 2426.3486
Distribution loss (46)m = 0.15 x (45)m	37.7526	33.2193	34.9020	29.7964	28.2706	24.8106	24.0205	25.3567	26.0548	29.8448	32.6972	37.2269 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000 (48)
Temperature factor from Table 2b												0.7930 (49)
Enter (49) or (54) in (55)												1.3481 (55)
Total storage loss	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906 (56)
If cylinder contains dedicated solar storage	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	316.7372	280.2192	297.7331	261.5970	253.5235	228.3583	225.1897	234.0976	236.6530	264.0186	280.9357	313.2320 (62)
WWHRS	-52.0516	-46.0349	-48.2051	-39.9157	-37.2000	-31.8323	-29.8377	-31.7294	-32.9350	-38.8267	-43.9859	-51.0877 (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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443 (64)
											Total per year (kWh/year) = Sum(64)m = 2708.6528 (64)	
											2709 (64)	

12Total per year (kWh/year)
Electric shower(s) 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month
135.7274 120.6420 129.4085 116.4122 114.7088 105.3604 105.2878 108.2497 108.1183 118.1984 122.8424 134.5619 (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	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	253.4691	280.6265	253.4691	261.9181	253.4691	261.9181	253.4691	253.4691	261.9181	253.4691	261.9181	253.4691 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.9238	505.1114	492.0387	464.2085	429.0778	396.0600	374.0020	368.8144	381.8871	409.7173	444.8479	477.8658 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044 (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)	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353 (71)
Water heating gains (Table 5)	182.4293	179.5268	173.9362	161.6837	154.1785	146.3338	141.5159	145.4969	150.1643	158.8689	170.6144	180.8628 (72)
Total internal gains	1006.8354	1036.2780	990.4573	958.8235	907.7387	875.3251	840.0003	838.7936	864.9827	893.0685	948.3937	983.2109 (73)

Full SAP Calculation Printout



6. Solar gains

[Jan]												Gains W	
	Area m2					Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	
Northeast	36.5800					11.2829		0.6800		0.7000		0.7700	136.1464 (75)
Southeast	11.8000					36.7938		0.6800		0.7000		0.7700	143.2179 (77)
Southwest	14.5500					36.7938		0.6800		0.7000		0.7700	176.5949 (79)
Northwest	13.8500					11.2829		0.6800		0.7000		0.7700	51.5481 (81)
Northeast	3.0000					18.0708		0.6800		0.7000		1.0000	28.3199 (82)
Southeast	1.5000					37.0308		0.6800		0.7000		1.0000	23.7960 (82)
Solar gains	559.6232	1031.0767	1612.9255	2329.8755	2906.7184	3014.9230	2853.0366	2403.8849	1858.7439	1194.5091	684.5843	469.6175 (83)	
Total gains	1566.4586	2067.3547	2603.3827	3288.6990	3814.4571	3890.2482	3693.0369	3242.6785	2723.7266	2087.5776	1632.9779	1452.8285 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, ThI (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	42.4412	42.5331	42.6254	43.0929	43.1877	43.6677	43.6677	43.7649	43.4744	43.1877	42.9986	42.8112
alpha	3.8294	3.8355	3.8417	3.8729	3.8792	3.9112	3.9112	3.9177	3.8983	3.8792	3.8666	3.8541
util living area	0.9871	0.9650	0.9100	0.7714	0.5824	0.4086	0.2998	0.3543	0.5977	0.8791	0.9732	0.9902 (86)
Living	19.2652	19.6442	20.1376	20.6470	20.9006	20.9805	20.9955	20.9916	20.9207	20.4856	19.7676	19.2016
Non living	18.2221	18.7036	19.3211	19.9387	20.2231	20.3100	20.3228	20.3215	20.2540	19.7631	18.8684	18.1447
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1126	19.6442	20.1376	20.6470	20.9006	20.9805	20.9955	20.9916	20.9207	20.4856	19.7676	19.4532 (87)
Th 2	20.3073	20.3087	20.3101	20.3171	20.3185	20.3255	20.3255	20.3269	20.3227	20.3185	20.3157	20.3129 (88)
util rest of house	0.9852	0.9601	0.8982	0.7466	0.5472	0.3678	0.2546	0.3040	0.5496	0.8584	0.9686	0.9887 (89)
MIT 2	19.4760	18.7036	19.3211	19.9387	20.2231	20.3100	20.3228	20.3215	20.2540	19.7631	18.8684	18.5354 (90)
Living area fraction	fLA = Living area / (4) = 0.2124 (91)											
MIT	19.6112	18.9034	19.4946	20.0892	20.3670	20.4525	20.4657	20.4639	20.3957	19.9166	19.0595	18.7304 (92)
Temperature adjustment	-0.1000											
adjusted MIT	19.5112	18.8034	19.3946	19.9892	20.2670	20.3525	20.3657	20.3639	20.2957	19.8166	18.9595	18.6304 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9825	0.9462	0.8796	0.7338	0.5445	0.3694	0.2573	0.3068	0.5476	0.8408	0.9564	0.9837 (94)
Useful gains	1539.0779	1956.1373	2290.0271	2413.2056	2076.9824	1437.2176	950.1892	994.7422	1491.6323	1755.1533	1561.8411	1429.1168 (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	3963.8876	3615.2635	3345.6730	2846.0307	2193.8936	1456.9376	953.7428	1001.7081	1576.1576	2360.2323	3050.3937	3727.9114 (97)
Space heating kWh	1804.0584	1114.9328	785.4005	311.6341	86.9819	0.0000	0.0000	0.0000	0.0000	450.1788	1071.7579	1710.3032 (98a)
Space heating requirement - total per year (kWh/year)	7335.2477											
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	1804.0584	1114.9328	785.4005	311.6341	86.9819	0.0000	0.0000	0.0000	0.0000	450.1788	1071.7579	1710.3032 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	7335.2477											
Space heating per m2	20.7774 (99)											

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)											
Fraction of space heat from main system(s)	1.0000 (202)											
Efficiency of main space heating system 1 (in %)	383.7031 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	60.0000 (208)											
Space heating requirement	1804.0584	1114.9328	785.4005	311.6341	86.9819	0.0000	0.0000	0.0000	0.0000	450.1788	1071.7579	1710.3032 (98)
Space heating efficiency (main heating system 1)	383.7031	383.7031	383.7031	383.7031	383.7031	0.0000	0.0000	0.0000	0.0000	383.7031	383.7031	383.7031 (210)
Space heating fuel (main heating system)	470.1704	290.5717	204.6896	81.2175	22.6691	0.0000	0.0000	0.0000	0.0000	117.3248	279.3196	445.7361 (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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443 (64)
Efficiency of water heater (217)m	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403 (216)
Fuel for water heating, kWh/month	140.0895	123.9462	132.0671	117.3287	114.4930	104.0148	103.3935	107.1069	107.8213	119.1868	125.4099	138.7445 (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	143.6230	129.7240	143.6230	138.9900	143.6230	138.9900	143.6230	143.6230	138.9900	143.6230	138.9900	143.6230 (231)
Lighting	44.1259	35.3995	31.8733	23.3517	18.0376	14.7368	16.4545	21.3881	27.7811	36.4503	41.1705	45.3523 (232)
Electricity generated by Pvs (Appendix M) (negative quantity)	-133.8970	-217.3920	-353.8520	-432.8085	-486.0041	-458.4778	-453.4070	-416.3721	-348.7015	-265.2520	-156.1156	-111.9257 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												

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(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-7.1637	-24.4287	-72.2950	-154.5277	-250.3279	-269.0160	-263.0291	-203.0760	-125.6062	-48.0420	-12.5373	-5.1810	(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													1911.6987 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													188.9403
Water heating fuel used													1433.6022 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900)													
mechanical ventilation fans (SFP = 1.1900)													1691.0450 (230a)
Total electricity for the above, kWh/year													1691.0450 (231)
Electricity for lighting (calculated in Appendix L)													356.1215 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-5269.4360 (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													123.0315 (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	1911.6987	0.1568	299.8416 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1433.6022	0.1406	201.6336 (264)
Space and water heating			501.4752 (265)
Pumps, fans and electric keep-hot	1691.0450	0.1387	234.5688 (267)
Energy for lighting	356.1215	0.1443	51.3993 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3834.2054	0.1328	-509.2038
PV Unit electricity exported	-1435.2306	0.1183	-169.8186
Total			-679.0224 (269)
Total CO2, kg/year			108.4209 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			0.3100 (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	1911.6987	1.5806	3021.6157 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1433.6022	1.5201	2179.1518 (278)
Space and water heating			5200.7676 (279)
Pumps, fans and electric keep-hot	1691.0450	1.5128	2558.2129 (281)
Energy for lighting	356.1215	1.5338	546.2311 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3834.2054	1.4907	-5715.8022
PV Unit electricity exported	-1435.2306	0.4339	-622.7802
Total			-6338.5824 (283)
Total Primary energy kWh/year			1966.6292 (286)
Dwelling Primary energy Rate (DPER)			5.5700 (287)

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

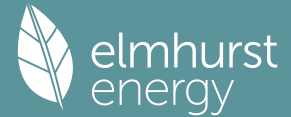
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1164.7920 (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)

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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) =	0.0343 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2843 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2843 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infiltr rate													
Effective ac	0.3625	0.3554	0.3483	0.3128	0.3057	0.2701	0.2701	0.2630	0.2843	0.3057	0.3199	0.3341	(22b)
	0.5657	0.5632	0.5607	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5512	0.5558	(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			5.6600	1.0000	5.6600			(26a)
TER Opening Type (Uw = 1.20)			76.7800	1.1450	87.9160			(27)
Dining			1.5000	2.0221	3.0331			(27a)
Lounge			1.5000	2.0221	3.0331			(27a)
Stair			1.5000	2.0221	3.0331			(27a)
Heatloss Floor 1			187.7400	0.1300	24.4062			(28a)
External Wall 1	427.0200	82.4400	344.5800	0.1800	62.0244			(29a)
External Roof 1	245.2300	4.5000	240.7300	0.1100	26.4803			(30)
External Roof 2	22.4400		22.4400	0.1100	2.4684			(30)
External Roof 3	43.4500		43.4500	0.1100	4.7795			(30)
Total net area of external elements Aum(A, m2)			925.8800					(31)
Fabric heat loss, W/K = Sum (A x U)					222.8341			(32)
								(26)...(30) + (32) = 222.8341 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 112.7780 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	48.5500	0.0500	2.4275
E3 Sill	37.0000	0.0500	1.8500
E4 Jamb	111.1000	0.0500	5.5550
R1 Head of roof window	3.6000	0.0800	0.2880
R2 Sill of roof window	3.6000	0.0600	0.2160
R3 Jamb of roof window	7.8000	0.0800	0.6240
E5 Ground floor (normal)	73.2500	0.1600	11.7200
E6 Intermediate floor within a dwelling	58.7500	0.0000	0.0000
E14 Flat roof	13.4000	0.0800	1.0720
E16 Corner (normal)	53.3200	0.0900	4.7988
E17 Corner (inverted - internal area greater than external area)	28.8400	-0.0900	-2.5956
E10 Eaves (insulation at ceiling level)	54.2500	0.0600	3.2550
E11 Eaves (insulation at rafter level)	31.3500	0.0400	1.2540
E13 Gable (insulation at rafter level)	22.5000	0.0800	1.8000
R4 Ridge (vaulted ceiling)	22.8000	0.0800	1.8240

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.0887 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 256.9228 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	217.4506	216.4697	215.5082	210.9923	210.1474	206.2142	206.2142	205.4859	207.7292	210.1474	211.8567	213.6436 (38)
Heat transfer coeff	474.3734	473.3925	472.4310	467.9151	467.0702	463.1370	463.1370	462.4087	464.6520	467.0702	468.7795	470.5664 (39)
Average = Sum(39)m / 12 =												467.9111

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3437	1.3409	1.3382	1.3254	1.3230	1.3119	1.3119	1.3098	1.3161	1.3230	1.3278	1.3329 (40)
HLP (average)												1.3254
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.2009 (42)
Hot water usage for mixer showers												77.8882 (42a)
Hot water usage for baths	77.8882	76.7177	75.0120	71.7485	69.3402	66.6544	65.1278	66.8206	68.6761	71.5598	74.8934	77.5898 (42a)
Hot water usage for other uses	33.6177	33.1184	32.4153	31.1190	30.1483	29.0720	28.4906	29.1887	29.9489	31.1006	32.4237	33.5040 (42b)
Average daily hot water use (litres/day)	47.4102	45.6862	43.9622	42.2382	40.5142	38.7902	38.7902	40.5142	42.2382	43.9622	45.6862	47.4102 (42c)
												146.0794 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	158.9161	155.5223	151.3896	145.1058	140.0027	134.5166	132.4086	136.5235	140.8632	146.6227	153.0033	158.5040 (44)
Energy content (annual)	251.6843	221.4617	232.6801	198.6425	188.4705	165.4038	160.1367	169.0446	173.6985	198.9656	217.9813	248.1790 (45)
Distribution loss (46)m = 0.15 x (45)m												2426.3486
Total = Sum(45)m =	37.7526	33.2193	34.9020	29.7964	28.2706	24.8106	24.0205	25.3567	26.0548	29.8448	32.6972	37.2269 (46)

Water storage loss:

Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7527 (55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

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Total heat required for water heating calculated for each month												
	298.2792	263.5474	279.2750	243.7344	235.0654	210.4956	206.7316	215.6395	218.7903	245.5605	263.0731	294.7739 (62)
WWHRS	-35.6072	-31.4913	-32.9759	-27.3053	-25.4476	-21.7757	-20.4112	-21.7053	-22.5300	-26.5604	-30.0897	-34.9478 (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	262.6719	232.0561	246.2991	216.4290	209.6178	188.7200	186.3204	193.9342	196.2603	219.0001	232.9834	259.8261 (64)
	Total per year (kWh/year) = Sum(64)m =											2644.1186 (64)
	Electric shower(s)											2644 (64)

Heat gains from water heating, kWh/month												
	120.9609	107.3046	114.6421	102.1221	99.9424	91.0702	90.5214	93.4833	93.8282	103.4320	108.5522	119.7954 (65)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
	Heat gains from water heating, kWh/month											0.0000 (64a)

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

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441	160.0441 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	252.1541	279.1706	252.1541	260.5593	252.1541	260.5593	252.1541	252.1541	260.5593	252.1541	260.5593	252.1541 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	499.9238	505.1114	492.0387	464.2085	429.0778	396.0600	374.0020	368.8144	381.8871	409.7173	444.8479	477.8658 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044	39.0044 (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)	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353 (71)
Water heating gains (Table 5)	162.5819	159.6795	154.0888	141.8363	134.3311	126.4864	121.6685	125.6495	130.3170	139.0215	150.7670	161.0154 (72)
Total internal gains	988.6730	1017.9747	972.2949	940.6173	889.5763	854.1189	818.8379	817.6313	843.7765	874.9061	930.1874	965.0485 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W						
Northeast	36.5800	11.2829	0.6300	0.7000	0.7700	126.1357 (75)						
Southeast	11.8000	36.7938	0.6300	0.7000	0.7700	132.6871 (77)						
Southwest	14.5500	36.7938	0.6300	0.7000	0.7700	163.6100 (79)						
Northwest	13.8500	11.2829	0.6300	0.7000	0.7700	47.7578 (81)						
Northeast	3.0000	18.0708	0.6300	0.7000	1.0000	26.2376 (82)						
Southeast	1.5000	37.0308	0.6300	0.7000	1.0000	22.0463 (82)						
Solar gains	518.4744	955.2622	1494.3280	2158.5611	2692.9891	2793.2375	2643.2545	2227.1287	1722.0715	1106.6775	634.2472	435.0868 (83)
Total gains	1507.1475	1973.2369	2466.6229	3099.1784	3582.5654	3647.3564	3462.0924	3044.7599	2565.8481	1981.5836	1564.4346	1400.1354 (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)												21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	23.3145	23.3628	23.4103	23.6362	23.6790	23.8801	23.8801	23.9177	23.8022	23.6790	23.5927	23.5031
alpha	2.5543	2.5575	2.5607	2.5757	2.5786	2.5920	2.5920	2.5945	2.5868	2.5786	2.5728	2.5669
util living area	0.9883	0.9764	0.9519	0.8916	0.7860	0.6434	0.5166	0.5840	0.7960	0.9389	0.9805	0.9903 (86)
MIT	17.7521	18.1221	18.7230	19.5283	20.2236	20.6852	20.8729	20.8220	20.4075	19.4772	18.4723	17.6976 (87)
Th 2	19.8068	19.8089	19.8110	19.8210	19.8229	19.8316	19.8316	19.8332	19.8282	19.8229	19.8191	19.8152 (88)
util rest of house	0.9861	0.9720	0.9426	0.8697	0.7409	0.5640	0.4029	0.4704	0.7343	0.9223	0.9762	0.9885 (89)
MIT 2	16.0037	16.4760	17.2388	18.2477	19.0798	19.5921	19.7651	19.7316	19.3202	18.2058	16.9316	15.9384 (90)
Living area fraction	16.3751	16.8257	17.5541	18.5197	19.3228	19.8244	20.0004	19.9632	19.5512	18.4759	17.2589	16.3121 (91)
MIT	16.3751	16.8257	17.5541	18.5197	19.3228	19.8244	20.0004	19.9632	19.5512	18.4759	17.2589	16.3121 (92)
Temperature adjustment												0.0000
adjusted MIT	16.3751	16.8257	17.5541	18.5197	19.3228	19.8244	20.0004	19.9632	19.5512	18.4759	17.2589	16.3121 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9754	0.9547	0.9169	0.8383	0.7183	0.5634	0.4207	0.4844	0.7165	0.8949	0.9610	0.9793 (94)
Useful gains	1470.1456	1883.8486	2261.7693	2598.1152	2573.4272	2054.9928	1456.4285	1474.9907	1838.4946	1773.3827	1503.3754	1371.1816 (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	5728.1036	5645.5524	5222.2981	4501.2164	3560.3818	2419.5945	1574.8516	1647.6702	2532.9010	3678.5932	4762.2897	5699.5611 (97)
Space heating kWh	3167.9207	2527.8650	2202.6334	1370.2329	734.2942	0.0000	0.0000	0.0000	0.0000	1417.4766	2346.4183	3220.3143 (98a)
Space heating requirement - total per year (kWh/year)	16987.1555											
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	3167.9207	2527.8650	2202.6334	1370.2329	734.2942	0.0000	0.0000	0.0000	0.0000	1417.4766	2346.4183	3220.3143 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	16987.1555											
Space heating per m ²	(98c) / (4) =											48.1168 (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)

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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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3167.9207	2527.8650	2202.6334	1370.2329	734.2942	0.0000	0.0000	0.0000	0.0000	1417.4766	2346.4183	3220.3143	(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)	3432.2002	2738.7486	2386.3851	1484.5427	795.5517	0.0000	0.0000	0.0000	0.0000	1535.7276	2542.1650	3488.9646	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating requirement	262.6719	232.0561	246.2991	216.4290	209.6178	188.7200	186.3204	193.9342	196.2603	219.0001	232.9834	259.8261	(64)
Efficiency of water heater (217)m	88.0397	87.9658	87.8040	87.4546	86.6303	79.8000	79.8000	79.8000	79.8000	87.4797	87.9045	79.8000	(216)
Fuel for water heating, kWh/month	298.3561	263.8025	280.5100	247.4759	241.9684	236.4912	233.4842	243.0253	245.9403	250.3440	265.0415	295.0607	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	52.3926	42.0313	37.8446	27.7265	21.4168	17.4977	19.5371	25.3951	32.9857	43.2790	48.8835	53.8488	(232)

Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-140.6506	-182.8551	-242.4271	-250.4444	-252.3514	-228.9466	-225.4517	-220.6765	-210.9369	-197.0422	-148.6904	-123.4276	(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	-134.2378	-273.5493	-528.5067	-773.1197	-1003.5062	-1002.1269	-990.8947	-847.8984	-633.2519	-384.7033	-176.9177	-106.9069	(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													18404.2855 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													79.8000 (216)
Water heating fuel used													3101.5000 (219)
Space cooling fuel													0.0000 (221)

Electricity for pumps and fans:													86.0000 (231)
Total electricity for the above, kWh/year													422.8387 (232)
Electricity for lighting (calculated in Appendix L)													

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-9279.5199 (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													12735.1043 (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	18404.2855	0.2100	3864.8999 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3101.5000	0.2100	651.3150 (264)
Space and water heating			4516.2150 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	422.8387	0.1443	61.0287 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2423.9005	0.1364	-330.7156
PV Unit electricity exported	-6855.6194	0.1267	-868.4621
Total			-1199.1777 (269)
Total CO2, kg/year			3389.9952 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6000 (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	18404.2855	1.1300	20796.8426 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3101.5000	1.1300	3504.6950 (278)
Space and water heating			24301.5376 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	422.8387	1.5338	648.5641 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2423.9005	1.5044	-3646.4139
PV Unit electricity exported	-6855.6194	0.4650	-3188.0806
Total			-6834.4945 (283)
Total Primary energy kWh/year			18245.7079 (286)
Target Primary Energy Rate (TPER)			51.6800 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1164.7920 (5)

2. Ventilation rate

	Value	Reference
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	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	40.0000 / (5) =	0.0343 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	1.0000	(17)
Infiltration rate	0.0843	(18)
Number of sides sheltered	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0843 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate	0.1075	0.1054	0.1033	0.0928	0.0907	0.0801	0.0801	0.0780	0.0843	0.0907	0.0949	0.0991 (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	0.5058	0.5056	0.5053	0.5043	0.5041	0.5032	0.5032	0.5030	0.5036	0.5041	0.5045	0.5049 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194		(27)
Opening Type 3			5.6600	1.0000	5.6600		(26a)
Dining			1.5000	0.9615	1.4423		(27a)
Lounge			1.5000	0.9615	1.4423		(27a)
Stair			1.5000	0.9615	1.4423		(27a)
Heatloss Floor 1			187.7400	0.0800	15.0192	110.0000	20651.4000 (28a)
External Wall 1	427.0200	82.4400	344.5800	0.0900	31.0122	9.0000	3101.2200 (29a)
External Roof 1	245.2300	4.5000	240.7300	0.1000	24.0730	9.0000	2166.5700 (30)
External Roof 2	22.4400		22.4400	0.1000	2.2440	9.0000	201.9600 (30)
External Roof 3	43.4500		43.4500	0.1000	4.3450	9.0000	391.0500 (30)
Total net area of external elements Aum(A, m ²)			925.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		146.1997		(33)
Internal Wall 1			100.0000			75.0000	7500.0000 (32c)
Internal Wall 2			145.0000			9.0000	1305.0000 (32c)
Internal Floor 1			165.3000			18.0000	2975.4000 (32d)
Internal Ceiling 1			169.1700			9.0000	1522.5300 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				39815.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							112.7780 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	48.5500	0.0700	3.3985
E3 Sill	37.0000	0.0400	1.4800
E4 Jamb	111.1000	0.0600	6.6660
R1 Head of roof window	3.6000	0.2400	0.8640
R2 Sill of roof window	3.6000	0.2400	0.8640
R3 Jamb of roof window	7.8000	0.2400	1.8720
E5 Ground floor (normal)	73.2500	0.0400	2.9300
E6 Intermediate floor within a dwelling	58.7500	0.0700	4.1125
E14 Flat roof	13.4000	0.1600	2.1440
E16 Corner (normal)	53.3200	0.1800	9.5976
E17 Corner (inverted - internal area greater than external area)	28.8400	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	54.2500	0.0400	2.1700
E11 Eaves (insulation at rafter level)	31.3500	0.1500	4.7025
E13 Gable (insulation at rafter level)	22.5000	0.2500	5.6250
R4 Ridge (vaulted ceiling)	22.8000	0.1200	2.7360
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			49.1621 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 195.3618 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	194.4131	194.3268	194.2422	193.8449	193.7706	193.4245	193.4245	193.3604	193.5578	193.7706	193.9209	194.0782 (38)
Heat transfer coeff												

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MIT 2	0.9883	0.9724	0.9363	0.8442	0.6900	0.5045	0.3547	0.4206	0.6922	0.9147	0.9780	0.9907 (89)
Living area fraction	17.4421	17.8236	18.4005	19.1067	19.6332	19.8972	19.9742	19.9575	19.7374	18.9923	18.0712	17.3647 (90)
MIT	17.6101	17.9922	18.5709	19.2827	19.8198	20.0952	20.1793	20.1594	19.9231	19.1637	18.2395	17.5326 (92)
Temperature adjustment												0.0000
adjusted MIT	17.6101	17.9922	18.5709	19.2827	19.8198	20.0952	20.1793	20.1594	19.9231	19.1637	18.2395	17.5326 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9821	0.9611	0.9188	0.8248	0.6812	0.5116	0.3716	0.4366	0.6870	0.8966	0.9684	0.9855 (94)	
Useful gains	1415.8017	1868.3483	2281.7422	2620.1276	2525.5573	1937.8057	1335.5951	1371.6761	1799.8146	1773.7223	1468.0034	1309.8318 (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	5187.9520	5101.8959	4702.8856	4041.0240	3159.6653	2136.4550	1391.5851	1461.3494	2264.7249	3332.4124	4336.3991	5192.2428 (97)	
Space heating kWh	2806.4798	2172.9440	1801.3306	1023.0454	471.7763	0.0000	0.0000	0.0000	0.0000	1159.6654	2065.2449	2888.5138 (98a)	
Space heating requirement - total per year (kWh/year)												14389.0003	
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	2806.4798	2172.9440	1801.3306	1023.0454	471.7763	0.0000	0.0000	0.0000	0.0000	1159.6654	2065.2449	2888.5138 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												14389.0003	
Space heating per m2												(98c) / (4) =	40.7574 (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	3654.5914	2877.0187	2954.2890	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7958	0.8520	0.8034	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2908.2280	2451.3342	2373.4881	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	4240.7207	4022.4409	3508.5706	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	959.3947	1168.9034	844.5014	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	239.8487	292.2259	211.1253	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												743.1999 (107)
Energy for space heating												40.7574 (99)
Energy for space cooling												2.1051 (108)
Total												42.8626 (109)
Fabric Energy Efficiency (DFEE)												42.9 (109)

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

1. Overall dwelling characteristics

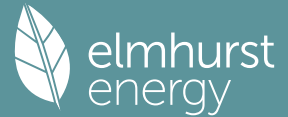
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1164.7920 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.0343 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2843 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2843 (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)

Full SAP Calculation Printout



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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1164.7920 (5)

2. Ventilation rate

	m ³ per hour											
Number of open chimneys	0 * 80 =											0.0000 (6a)
Number of open flues	0 * 20 =											0.0000 (6b)
Number of chimneys / flues attached to closed fire	1 * 10 =											10.0000 (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)	10.0000 / (5) =											0.0086 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												1.0000 (17)
Infiltration rate												0.0586 (18)
Number of sides sheltered												0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.0586 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Balanced mechanical ventilation with heat recovery	0.0747	0.0732	0.0718	0.0644	0.0630	0.0557	0.0557	0.0542	0.0586	0.0630	0.0659	0.0688 (22b)
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1697	0.1682	0.1668	0.1594	0.1580	0.1507	0.1507	0.1492	0.1536	0.1580	0.1609	0.1638 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194		(27)
Opening Type 3			5.6600	1.0000	5.6600		(26a)
Dining			1.5000	0.9615	1.4423		(27a)
Lounge			1.5000	0.9615	1.4423		(27a)
Stair			1.5000	0.9615	1.4423		(27a)
Heatloss Floor 1			187.7400	0.0800	15.0192	110.0000	20651.4000 (28a)
External Wall 1	427.0200	82.4400	344.5800	0.0900	31.0122	9.0000	3101.2200 (29a)
External Roof 1	245.2300	4.5000	240.7300	0.1000	24.0730	9.0000	2166.5700 (30)
External Roof 2	22.4400		22.4400	0.1000	2.2440	9.0000	201.9600 (30)
External Roof 3	43.4500		43.4500	0.1000	4.3450	9.0000	391.0500 (30)
Total net area of external elements Aum(A, m ²)			925.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	146.1997			(33)
Internal Wall 1			100.0000			75.0000	7500.0000 (32c)
Internal Wall 2			145.0000			9.0000	1305.0000 (32c)
Internal Floor 1			165.3000			18.0000	2975.4000 (32d)
Internal Ceiling 1			169.1700			9.0000	1522.5300 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				39815.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							112.7780 (35)
List of Thermal Bridges				Length	Psi-value		Total
K1 Element				48.5500	0.0700		3.3985
E2 Other lintels (including other steel lintels)				37.0000	0.0400		1.4800
E3 Sill				111.1000	0.0600		6.6660
E4 Jamb				3.6000	0.2400		0.8640
R1 Head of roof window				3.6000	0.2400		0.8640
R2 Sill of roof window				7.8000	0.2400		1.8720
R3 Jamb of roof window				73.2500	0.0400		2.9300
E5 Ground floor (normal)				58.7500	0.0700		4.1125
E6 Intermediate floor within a dwelling				13.4000	0.1600		2.1440
E14 Flat roof				53.3200	0.1800		9.5976
E16 Corner (normal)				28.8400	0.0000		0.0000
E17 Corner (inverted - internal area greater than external area)				54.2500	0.0400		2.1700
E10 Eaves (insulation at ceiling level)				31.3500	0.1500		4.7025
E11 Eaves (insulation at rafter level)				22.5000	0.2500		5.6250
E13 Gable (insulation at rafter level)				22.8000	0.1200		2.7360
R4 Ridge (vaulted ceiling)							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							49.1621 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 195.3618 (37)

Full SAP Calculation Printout



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	-121.1243 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1669.3906	16.4900	275.2825 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1433.6022	16.4900	236.4010 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	1691.0450	16.4900	278.8533 (249)
Energy for lighting	354.2740	16.4900	58.4198 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3822.6661	16.4900	-630.3576
PV Unit electricity exported	-1446.7699	5.5900	-80.8744
Total			-711.2321 (252)
Total energy cost			137.7245 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1246 (257)
SAP value		97.9808
SAP rating (Section 12)		98 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1669.3906	0.1574	262.7704 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1433.6022	0.1406	201.6336 (264)
Space and water heating			464.4040 (265)
Pumps, fans and electric keep-hot	1691.0450	0.1387	234.5688 (267)
Energy for lighting	354.2740	0.1443	51.1327 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3822.6661	0.1328	-507.5430
PV Unit electricity exported	-1446.7699	0.1186	-171.6082
Total			-679.1512 (269)
Total CO2, kg/year			70.9542 (272)
CO2 emissions per m2			0.2000 (273)
EI value			99.7611
EI rating			100 (274)
EI band			A

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

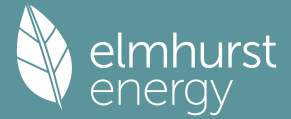
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1164.7920 (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	1 * 10 =	10.0000 (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) =	10.0000 / (5) = 0.0086 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		1.0000 (17)
Infiltration rate		0.0586 (18)
Number of sides sheltered		0 (19)

Full SAP Calculation Printout



Shelter factor														(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor														(21) = (18) x (20) = 0.0586 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind factor	6.6000	6.2000	6.1000	5.6000	5.5000	4.7000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000	(22)	
Adj infilt rate	1.6500	1.5500	1.5250	1.4000	1.3750	1.1750	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250	(22a)	
Balanced mechanical ventilation with heat recovery	0.0967	0.0908	0.0893	0.0820	0.0806	0.0688	0.0674	0.0659	0.0732	0.0849	0.0879	0.0952	(22b)	
If mechanical ventilation													0.5000 (23a)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													81.0000 (23c)	
Effective ac	0.1917	0.1858	0.1843	0.1770	0.1756	0.1638	0.1624	0.1609	0.1682	0.1799	0.1829	0.1902	(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	
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194			(27)
Opening Type 3			5.6600	1.0000	5.6600			(26a)
Dining			1.5000	0.9615	1.4423			(27a)
Lounge			1.5000	0.9615	1.4423			(27a)
Stair			1.5000	0.9615	1.4423			(27a)
Heatloss Floor 1			187.7400	0.0800	15.0192	110.0000	20651.4000	(28a)
External Wall 1	427.0200	82.4400	344.5800	0.0900	31.0122	9.0000	3101.2200	(29a)
External Roof 1	245.2300	4.5000	240.7300	0.1000	24.0730	9.0000	2166.5700	(30)
External Roof 2	22.4400		22.4400	0.1000	2.2440	9.0000	201.9600	(30)
External Roof 3	43.4500		43.4500	0.1000	4.3450	9.0000	391.0500	(30)
Total net area of external elements Aum(A, m2)			925.8800					(31)
Fabric heat loss, W/K = Sum(A x U)				(26)...(30) + (32) =	146.1997			(33)
Internal Wall 1			100.0000			75.0000	7500.0000	(32c)
Internal Wall 2			145.0000			9.0000	1305.0000	(32c)
Internal Floor 1			165.3000			18.0000	2975.4000	(32d)
Internal Ceiling 1			169.1700			9.0000	1522.5300	(32e)
Heat capacity Cm = Sum(A x k)								(28)...(30) + (32) + (32a)...(32e) = 39815.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								112.7780 (35)

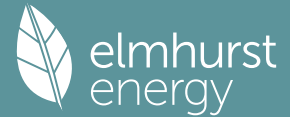
List of Thermal Bridges	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	48.5500	0.0700	3.3985	
E3 Sill	37.0000	0.0400	1.4800	
E4 Jamb	111.1000	0.0600	6.6660	
R1 Head of roof window	3.6000	0.2400	0.8640	
R2 Sill of roof window	3.6000	0.2400	0.8640	
R3 Jamb of roof window	7.8000	0.2400	1.8720	
E5 Ground floor (normal)	73.2500	0.0400	2.9300	
E6 Intermediate floor within a dwelling	58.7500	0.0700	4.1125	
E14 Flat roof	13.4000	0.1600	2.1440	
E16 Corner (normal)	53.3200	0.1800	9.5976	
E17 Corner (inverted - internal area greater than external area)	28.8400	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	54.2500	0.0400	2.1700	
E11 Eaves (insulation at rafter level)	31.3500	0.1500	4.7025	
E13 Gable (insulation at rafter level)	22.5000	0.2500	5.6250	
R4 Ridge (vaulted ceiling)	22.8000	0.1200	2.7360	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				49.1621 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 195.3618 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	73.6727	71.4208	70.8578	68.0429	67.4799	62.9761	62.4132	61.8502	64.6651	69.1689	70.2948	73.1097	(38)
Heat transfer coeff	269.0345	266.7826	266.2196	263.4047	262.8418	258.3379	257.7750	257.2120	260.0269	264.5307	265.6566	268.4715	(39)
Average = Sum(39)m / 12 =													263.3578
HLP	0.7621	0.7557	0.7541	0.7461	0.7445	0.7318	0.7302	0.7286	0.7365	0.7493	0.7525	0.7605	(40)
HLP (average)													0.7460
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													3.2009 (42)
Hot water usage for baths	77.8882	76.7177	75.0120	71.7485	69.3402	66.6544	65.1278	66.8206	68.6761	71.5598	74.8934	77.5898	(42a)
Hot water usage for other uses	33.6177	33.1184	32.4153	31.1190	30.1483	29.0720	28.4906	29.1887	29.9489	31.1006	32.4237	33.5040	(42b)
Average daily hot water use (litres/day)	47.4102	45.6862	43.9622	42.2382	40.5142	38.7902	38.7902	40.5142	42.2382	43.9622	45.6862	47.4102	(42c)
Daily hot water use	158.9161	155.5223	151.3896	145.1058	140.0027	134.5166	132.4086	136.5235	140.8632	146.6227	153.0033	158.5040	(44)
Energy conte (annual)	251.6843	221.4617	232.6801	198.6425	188.4705	165.4038	160.1367	169.0446	173.6985	198.9656	217.9813	248.1790	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2426.3486
Water storage loss:	37.7526	33.2193	34.9020	29.7964	28.2706	24.8106	24.0205	25.3567	26.0548	29.8448	32.6972	37.2269	(46)
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7000 (48)
Temperature factor from Table 2b													0.7930 (49)
Enter (49) or (54) in (55)													1.3481 (55)
Total storage loss	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	(56)
If cylinder contains dedicated solar storage	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	316.7372	280.2192	297.7331	261.5970	253.5235	228.3583	225.1897	234.0976	236.6530	264.0186	280.9357	313.2320	(62)

Full SAP Calculation Printout



WWHRS	-52.0516	-46.0349	-48.2051	-39.9157	-37.2000	-31.8323	-29.8377	-31.7294	-32.9350	-38.8267	-43.9859	-51.0877 (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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443 (64)
								Total per year (kWh/year) = Sum(64)m =				2708.6528 (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	135.7274	120.6420	129.4085	116.4122	114.7088	105.3604	105.2878	108.2497	108.1183	118.1984	122.8424	134.5619 (65)

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

Metabolic gains (Table 5), Watts (66m)	Jan 192.0529	Feb 192.0529	Mar 192.0529	Apr 192.0529	May 192.0529	Jun 192.0529	Jul 192.0529	Aug 192.0529	Sep 192.0529	Oct 192.0529	Nov 192.0529	Dec 192.0529 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1511	44.5438	36.2255	27.4250	20.5005	17.3074	18.7012	24.3086	32.6269	41.4274	48.3519	51.5450 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	746.1549	753.8976	734.3861	692.8485	640.4147	591.1343	558.2120	550.4692	569.9807	611.5183	663.9522	713.2325 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062 (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)	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353 (71)
Water heating gains (Table 5)	182.4293	179.5268	173.9362	161.6837	154.1785	146.3338	141.5159	145.4969	150.1643	158.8689	170.6144	180.8628 (72)
Total internal gains	1100.1591	1099.3921	1065.9716	1003.3810	936.5175	876.1993	839.8529	841.6985	874.1958	933.2384	1004.3422	1067.0641 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W					
Northeast	36.5800	15.8649	0.6800	0.7000	1.0000	248.6163 (75)						
Southeast	11.8000	48.0626	0.6800	0.7000	1.0000	242.9622 (77)						
Southwest	14.5500	48.0626	0.6800	0.7000	1.0000	299.5847 (79)						
Northwest	13.8500	15.8649	0.6800	0.7000	1.0000	94.1317 (81)						
Northeast	3.0000	25.7636	0.6800	0.7000	1.0000	40.3319 (82)						
Southeast	1.5000	50.6482	0.6800	0.7000	1.0000	32.5465 (82)						
Solar gains	958.1733	1527.2364	2373.8633	3524.7774	4169.5614	4714.7343	4031.3560	3661.5446	2877.4541	1829.1915	1125.1986	779.0702 (83)
Total gains	2058.3325	2626.6285	3439.8349	4528.1584	5106.0790	5590.9337	4871.2089	4503.2431	3751.6499	2762.4299	2129.5409	1846.1344 (84)

7. Mean internal temperature (heating season)

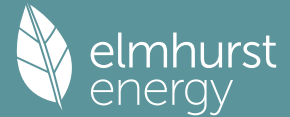
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.1091	41.4561	41.5437	41.9877	42.0776	42.8112	42.9047	42.9986	42.5331	41.8090	41.6318	41.1953	
alpha	3.7406	3.7637	3.7696	3.7992	3.8052	3.8541	3.8603	3.8666	3.8355	3.7873	3.7755	3.7464	
util living area	0.9498	0.8977	0.7897	0.6086	0.4496	0.2983	0.2531	0.2672	0.4200	0.7084	0.8992	0.9583 (86)	
Living	19.8898	20.2031	20.5588	20.8478	20.9570	20.9929	20.9971	20.9966	20.9773	20.8042	20.3477	19.8787	
Non living	19.0000	19.3894	19.8135	20.1454	20.2621	20.3074	20.3124	20.3135	20.2910	20.1081	19.5767	18.9891	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.4321	20.2031	20.5588	20.8478	20.9570	20.9929	20.9971	20.9966	20.9773	20.8042	20.3477	20.0355 (87)	
Th 2	20.2863	20.2919	20.2933	20.3003	20.3017	20.3129	20.3143	20.3157	20.3087	20.2975	20.2947	20.2877 (88)	
util rest of house	0.9419	0.8837	0.7668	0.5792	0.4175	0.2674	0.2172	0.2288	0.3759	0.6695	0.8820	0.9512 (89)	
MIT 2	19.7735	19.3894	19.8135	20.1454	20.2621	20.3074	20.3124	20.3135	20.2910	20.1081	19.5767	19.2231 (90)	
Living area fraction									fLA = Living area / (4) =			0.2124 (91)	
MIT	19.9134	19.5622	19.9718	20.2946	20.4097	20.4530	20.4579	20.4586	20.4368	20.2560	19.7405	19.3957 (92)	
Temperature adjustment												-0.1000	
adjusted MIT	19.8134	19.4622	19.8718	20.1946	20.3097	20.3530	20.3579	20.3586	20.3368	20.1560	19.6405	19.2957 (93)	

8. Space heating requirement

Utilisation	Jan 0.9359	Feb 0.8645	Mar 0.7521	Apr 0.5746	May 0.4179	Jun 0.2692	Jul 0.2195	Aug 0.2312	Sep 0.3777	Oct 0.6611	Nov 0.8631	Dec 0.9387 (94)		
Useful gains	1926.3861	2270.6936	2586.9417	2601.9338	2133.9194	1504.8959	1069.3767	1041.1150	1416.9719	1826.3135	1837.9918	1733.0313 (95)		
Ext temp.	7.0000	7.3000	8.1000	9.6000	12.0000	14.5000	16.2000	16.3000	14.8000	12.4000	9.8000	7.6000 (96)		
Heat loss rate W	3447.2505	3244.6736	3133.8929	2790.6707	2184.1410	1512.0504	1071.7990	1043.9320	1439.7180	2051.6950	2614.1961	3139.9613 (97)		
Space heating kWh	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559 (98a)		
Space heating requirement - total per year (kWh/year)												4139.5316		
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	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559 (98c)		
Space heating requirement after solar contribution - total per year (kWh/year)												4139.5316		
Space heating per m ²													(98c) / (4) =	11.7254 (99)

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

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Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													383.6166	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													60.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559	(98)	
Space heating efficiency (main heating system 1)	383.6166	383.6166	383.6166	383.6166	383.6166	0.0000	0.0000	0.0000	0.0000	383.6166	383.6166	383.6166	(210)	
Space heating fuel (main heating system)	294.9620	170.6169	106.0777	35.4235	9.7402	0.0000	0.0000	0.0000	0.0000	43.7113	145.6838	272.8651	(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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443	(64)	
Efficiency of water heater (217)m	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	(216)	
Fuel for water heating, kWh/month	140.0780	123.9360	132.0562	117.3190	114.4836	104.0063	103.3849	107.0981	107.8124	119.1769	125.3995	138.7330	(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	143.6230	129.7240	143.6230	138.9900	143.6230	138.9900	143.6230	143.6230	138.9900	143.6230	138.9900	143.6230	(231)	
Lighting	43.8970	35.2158	31.7079	23.2306	17.9440	14.6604	16.3691	21.2772	27.6369	36.2612	40.9569	45.1170	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-178.1530	-248.1262	-391.8206	-477.8629	-516.2077	-509.1035	-478.9106	-462.2022	-399.0052	-306.4661	-197.5805	-145.1830	(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	-14.7800	-36.9074	-103.6398	-219.1874	-310.1908	-380.8554	-312.9937	-276.8477	-179.2122	-74.3284	-23.6489	-10.1272	(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													1079.0805	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													188.9559	
Water heating fuel used													1433.4839	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900)														
mechanical ventilation fans (SFP = 1.1900)													1691.0450	(230a)
Total electricity for the above, kWh/year													1691.0450	(231)
Electricity for lighting (calculated in Appendix L)													354.2740	(232)
Energy saving/generation technologies (Appendices M, N and Q)														
PV generation													-6253.3404	(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													-1695.4570	(238)

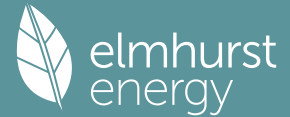
10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1079.0805	21.5100	232.1102	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1433.4839	21.5100	308.3424	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	1691.0450	21.5100	363.7438	(249)
Energy for lighting	354.2740	21.5100	76.2043	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4310.6215	21.5100	-927.2147	
PV Unit electricity exported	-1942.7189	5.5900	-108.5980	
Total			-1035.8127	(252)
Total energy cost			-55.4119	(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	1079.0805	0.1579	170.3787	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1433.4839	0.1406	201.6170	(264)
Space and water heating			371.9956	(265)
Pumps, fans and electric keep-hot	1691.0450	0.1387	234.5688	(267)
Energy for lighting	354.2740	0.1443	51.1327	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4310.6215	0.1334	-575.0371	
PV Unit electricity exported	-1942.7189	0.1197	-232.4719	
Total			-807.5090	(269)
Total CO2, kg/year			-149.8119	(272)

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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	1079.0805	1.5844	1709.7261 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1433.4839	1.5201	2178.9721 (278)
Space and water heating			3888.6982 (279)
Pumps, fans and electric keep-hot	1691.0450	1.5128	2558.2129 (281)
Energy for lighting	354.2740	1.5338	543.3972 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-4310.6215	1.4929	-6435.5332
PV Unit electricity exported	-1942.7189	0.4390	-852.8678
Total			-7288.4010 (283)
Total Primary energy kWh/year			-298.0927 (286)

SAP 10 EPC IMPROVEMENTS

New Build Dwelling

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

Recommended measures:	SAP change	Cost change	CO2 change
V2 Wind turbine	+ 6.9	-£ 598	-496 kg (331.1%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.8	-£ 81	-59 kg (39.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Wind turbine	£598	1.40 kg/m ²	A 105 A 101
Total Savings	£598	1.40 kg/m²	
Potential energy efficiency rating:			A 105
Potential environmental impact rating:			A 101

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 £980	Potential £980	Saving £0
Electricity			
Space heating	£596	£596	£0
Water heating	£308	£308	£0
Lighting	£76	£76	£0
Generated (PV)	-£1036	-£1036	£0
Generated (wind)	-£0	-£598	£598
Total cost of fuels	-£156	-£654	£598
Total cost of uses	-£156	-£654	£598
Delivered energy	-5 kWh/m ²	-15 kWh/m ²	10 kWh/m ²
Carbon dioxide emissions	-0.1 tonnes	-0.6 tonnes	0.5 tonnes
CO2 emissions per m ²	-0 kg/m ²	-2 kg/m ²	1 kg/m ²
Primary energy	-1 kWh/m ²	-13 kWh/m ²	12 kWh/m ²

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

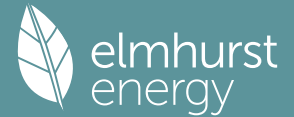
1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1164.7920 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	1 * 10 = 10.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)

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Number of flues attached to other heater 0 * 35 = 0.0000 (6e)
 Number of blocked chimneys 0 * 20 = 0.0000 (6f)
 Number of intermittent extract fans 0 * 10 = 0.0000 (7a)
 Number of passive vents 0 * 10 = 0.0000 (7b)
 Number of flueless gas fires 0 * 40 = 0.0000 (7c)

Air changes per hour 10.0000 / (5) = 0.0086 (8)
 Pressure Test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 1.0000 (17)
 Infiltration rate 0.0586 (18)
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.0586 (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
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750
Adj infilt rate	0.0747	0.0732	0.0718	0.0644	0.0630	0.0557	0.0557	0.0542	0.0586	0.0630	0.0659	0.0688
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.1697	0.1682	0.1668	0.1594	0.1580	0.1507	0.1507	0.1492	0.1536	0.1580	0.1609	0.1638 (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
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194		(27)
Opening Type 3			5.6600	1.0000	5.6600		(26a)
Dining			1.5000	0.9615	1.4423		(27a)
Lounge			1.5000	0.9615	1.4423		(27a)
Stair			1.5000	0.9615	1.4423		(27a)
Heatloss Floor 1			187.7400	0.0800	15.0192	110.0000	20651.4000 (28a)
External Wall 1	427.0200	82.4400	344.5800	0.0900	31.0122	9.0000	3101.2200 (29a)
External Roof 1	245.2300	4.5000	240.7300	0.1000	24.0730	9.0000	2166.5700 (30)
External Roof 2	22.4400		22.4400	0.1000	2.2440	9.0000	201.9600 (30)
External Roof 3	43.4500		43.4500	0.1000	4.3450	9.0000	391.0500 (30)
Total net area of external elements Aum(A, m2)			925.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		146.1997		(33)
Internal Wall 1			100.0000			75.0000	7500.0000 (32c)
Internal Wall 2			145.0000			9.0000	1305.0000 (32c)
Internal Floor 1			165.3000			18.0000	2975.4000 (32d)
Internal Ceiling 1			169.1700			9.0000	1522.5300 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				39815.1300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							112.7780 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	48.5500	0.0700	3.3985
E3 Sill	37.0000	0.0400	1.4800
E4 Jamb	111.1000	0.0600	6.6660
R1 Head of roof window	3.6000	0.2400	0.8640
R2 Sill of roof window	3.6000	0.2400	0.8640
R3 Jamb of roof window	7.8000	0.2400	1.8720
E5 Ground floor (normal)	73.2500	0.0400	2.9300
E6 Intermediate floor within a dwelling	58.7500	0.0700	4.1125
E14 Flat roof	13.4000	0.1600	2.1440
E16 Corner (normal)	53.3200	0.1800	9.5976
E17 Corner (inverted - internal area greater than external area)	28.8400	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	54.2500	0.0400	2.1700
E11 Eaves (insulation at rafter level)	31.3500	0.1500	4.7025
E13 Gable (insulation at rafter level)	22.5000	0.2500	5.6250
R4 Ridge (vaulted ceiling)	22.8000	0.1200	2.7360
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			49.1621 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 195.3618 (37)

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

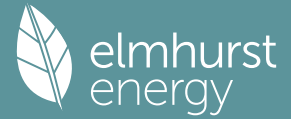
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	65.2280	64.6651	64.1021	61.2872	60.7242	57.9093	57.9093	57.3464	59.0353	60.7242	61.8502	62.9761 (38)
Heat transfer coeff	260.5898	260.0269	259.4639	256.6490	256.0860	253.2711	253.2711	252.7082	254.3971	256.0860	257.2120	258.3379 (39)
Average = Sum(39)m / 12 =												256.5083
HLP (average)	0.7381	0.7365	0.7349	0.7270	0.7254	0.7174	0.7174	0.7158	0.7206	0.7254	0.7286	0.7318 (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 3.2009 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	77.8882	76.7177	75.0120	71.7485	69.3402	66.6544	65.1278	66.8206	68.6761	71.5598	74.8934	77.5898 (42a)
Hot water usage for baths	33.6177	33.1184	32.4153	31.1190	30.1483	29.0720	28.4906	29.1887	29.9489	31.1006	32.4237	33.5040 (42b)
Hot water usage for other uses	47.4102	45.6862	43.9622	42.2382	40.5142	38.7902	38.7902	40.5142	42.2382	43.9622	45.6862	47.4102 (42c)
Average daily hot water use (litres/day)												146.0794 (43)
Daily hot water use	158.9161	155.5223	151.3896	145.1058	140.0027	134.5166	132.4086	136.5235	140.8632	146.6227	153.0033	158.5040 (44)
Energy conte	251.6843	221.4617	232.6801	198.6425	188.4705	165.4038	160.1367	169.0446	173.6985	198.9656	217.9813	248.1790 (45)
Energy content (annual)												Total = Sum(45)m = 2426.3486
Distribution loss (46)m = 0.15 x (45)m	37.7526	33.2193	34.9020	29.7964	28.2706	24.8106	24.0205	25.3567	26.0548	29.8448	32.6972	37.2269 (46)

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Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.7930 (49)
Enter (49) or (54) in (55) 1.3481 (55)
Total storage loss

41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	40.4425	41.7906	40.4425
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If cylinder contains dedicated solar storage

41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	40.4425	41.7906	40.4425
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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 22.5120 23.2624 22.5120

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 0.0000 0.0000

Total heat required for water heating calculated for each month

316.7372	280.2192	297.7331	261.5970	253.5235	228.3583	225.1897	234.0976	236.6530	264.0186	280.9357	313.2320	(62)
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WWHRS -52.0516 -46.0349 -48.2051 -39.9157 -37.2000 -31.8323 -29.8377 -31.7294 -32.9350 -38.8267 -43.9859 -51.0877 (63a)

PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)

Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)

FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)

Output from w/h

264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443	(64)
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Total per year (kWh/year) = Sum(64)m = 2708.6528 (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)
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Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

135.7274	120.6420	129.4085	116.4122	114.7088	105.3604	105.2878	108.2497	108.1183	118.1984	122.8424	134.5619	(65)
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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
192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

50.1511	44.5438	36.2255	27.4250	20.5005	17.3074	18.7012	24.3086	32.6269	41.4274	48.3519	51.5450	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

746.1549	753.8976	734.3861	692.8485	640.4147	591.1343	558.2120	550.4692	569.9807	611.5183	663.9522	713.2325	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062
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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)

-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353
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Water heating gains (Table 5)

182.4293	179.5268	173.9362	161.6837	154.1785	146.3338	141.5159	145.4969	150.1643	158.8689	170.6144	180.8628	(72)
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Total internal gains

1100.1591	1099.3921	1065.9716	1003.3810	936.5175	876.1993	839.8529	841.6985	874.1958	933.2384	1004.3422	1067.0641	(73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	36.5800	11.2829	0.6800	0.7000	1.0000	176.8135 (75)
Southeast	11.8000	36.7938	0.6800	0.7000	1.0000	185.9972 (77)
Southwest	14.5500	36.7938	0.6800	0.7000	1.0000	229.3441 (79)
Northwest	13.8500	11.2829	0.6800	0.7000	1.0000	66.9455 (81)
Northeast	3.0000	18.0708	0.6800	0.7000	1.0000	28.3199 (82)
Southeast	1.5000	37.0308	0.6800	0.7000	1.0000	23.7960 (82)

Solar gains 711.2163 1307.9181 2041.1765 2943.4091 3669.6035 3805.5788 3601.4604 3035.7968 2350.3560 1513.8147 869.5491 597.1552 (83)

Total gains 1811.3754 2407.3102 3107.1481 3946.7901 4606.1210 4681.7781 4441.3133 3877.4953 3224.5518 2447.0532 1873.8914 1664.2193 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
42.4412	42.5331	42.6254	43.0929	43.1877	43.6677	43.6677	43.6677	43.7649	43.4744	43.1877	42.9986	42.8112

alpha 3.8294 3.8355 3.8417 3.8729 3.8792 3.9112 3.9112 3.9177 3.8983 3.8792 3.8666 3.8541

util living area

0.9794	0.9453	0.8618	0.6906	0.4969	0.3426	0.2501	0.2979	0.5200	0.8273	0.9591	0.9845	(86)
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Living 19.4060 19.8179 20.3285 20.7643 20.9424 20.9895 20.9977 20.9955 20.9510 20.6031 19.8967 19.3255

Non living 18.4009 18.9208 19.5515 20.0693 20.2642 20.3173 20.3241 20.3241 20.2812 19.8984 19.0303 18.3024

24 / 16 0 0 0 0 0 0 0 0 0 0 0 0

24 / 9 3 0 0 0 0 0 0 0 0 0 0 0

16 / 9 28 0 0 0 0 0 0 0 0 0 0 10

MIT 20.1846 19.8179 20.3285 20.7643 20.9424 20.9895 20.9977 20.9955 20.9510 20.6031 19.8967 19.5598 (87)

Th 2 20.3073 20.3087 20.3101 20.3171 20.3185 20.3255 20.3255 20.3269 20.3227 20.3185 20.3157 20.3129 (88)

util rest of house

0.9764	0.9382	0.8459	0.6636	0.4644	0.3075	0.2121	0.2550	0.4748	0.8017	0.9525	0.9823	(89)
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MIT 2 19.5473 18.9208 19.5515 20.0693 20.2642 20.3173 20.3241 20.3241 20.2812 19.8984 19.0303 18.6647 (90)

Living area fraction

19.6826	19.1114	19.7166	20.2169	20.4083	20.4601	20.4672	20.4667	20.4235	20.0481	19.2143	18.8549	(92)
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Temperature adjustment

19.5826	19.0114	19.6166	20.1169	20.3083	20.3601	20.3672	20.3667	20.3235	19.9481	19.1143	18.7549	(93)
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adjusted MIT

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9727	0.9215	0.8279	0.6553	0.4639	0.3094	0.2144	0.2576	0.4749	0.7862	0.9376	0.9754	(94)

Useful gains 1761.9340 2218.2889 2572.5052 2586.4562 2136.6749 1448.3305 952.2907 998.6984 1531.2992 1923.9461 1757.0360 1623.3427 (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

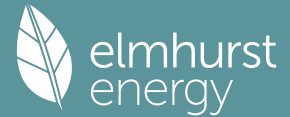
3982.5032	3669.3305	3403.2755	2878.8147	2204.4539	1458.8663	954.1209	1002.4143	1583.2429	2393.9169	3090.2267	3760.0710	(97)
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Space heating kWh

1652.1035	975.0999	618.0931	210.4981	50.4276	0.0000	0.0000	0.0000	0.0000	349.6583	959.8973	1589.7259	(98a)
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Space heating requirement - total per year (kWh/year) 6405.5037

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Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)													0.0000
Space heating kWh	1652.1035	975.0999	618.0931	210.4981	50.4276	0.0000	0.0000	0.0000	0.0000	349.6583	959.8973	1589.7259	98c)
Space heating requirement after solar contribution - total per year (kWh/year)													6405.5037
Space heating per m2													(98c) / (4) = 18.1438 (99)

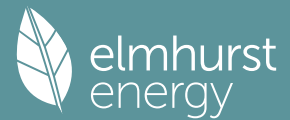
9a. Energy requirements - Individual heating systems, including micro-CHP

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 %)													383.7031 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													60.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1652.1035	975.0999	618.0931	210.4981	50.4276	0.0000	0.0000	0.0000	0.0000	349.6583	959.8973	1589.7259	(98)
Space heating efficiency (main heating system 1)	383.7031	383.7031	383.7031	383.7031	383.7031	0.0000	0.0000	0.0000	0.0000	383.7031	383.7031	383.7031	(210)
Space heating fuel (main heating system)	430.5682	254.1287	161.0863	54.8596	13.1423	0.0000	0.0000	0.0000	0.0000	91.1273	250.1667	414.3114	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443	(64)
Efficiency of water heater (217)m	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	188.9403	(216)
Fuel for water heating, kWh/month	140.0895	123.9462	132.0671	117.3287	114.4930	104.0148	103.3935	107.1069	107.8213	119.1868	125.4099	138.7445	(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	143.6230	129.7240	143.6230	138.9900	143.6230	138.9900	143.6230	143.6230	138.9900	143.6230	138.9900	143.6230	(231)
Lighting	43.8970	35.2158	31.7079	23.2306	17.9440	14.6604	16.3691	21.2772	27.6369	36.2612	40.9569	45.1170	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-133.7004	-216.6439	-351.2367	-428.9523	-483.6745	-458.4561	-453.3831	-416.3473	-348.6808	-263.9839	-155.7985	-111.8086	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-7.3603	-25.1768	-74.9103	-158.3839	-252.6575	-269.0377	-263.0530	-203.1007	-125.6269	-49.3101	-12.8544	-5.2981	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	(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													1669.3906 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													188.9403
Water heating fuel used													1433.6022 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900) mechanical ventilation fans (SFP = 1.1900)													1691.0450 (230a)
Total electricity for the above, kWh/year													1691.0450 (231)
Electricity for lighting (calculated in Appendix L)													354.2740 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV generation													-5269.4360 (233)
Wind generation													-3575.5408 (234)
Hydro-electric generation (Appendix N)													0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (235)
Appendix Q - special features													
Energy saved or generated													-0.0000 (236)
Energy used													0.0000 (237)
Total delivered energy for all uses													-3696.6650 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1669.3906	16.4900	275.2825 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1433.6022	16.4900	236.4010 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	1691.0450	16.4900	278.8533 (249)
Energy for lighting	354.2740	16.4900	58.4198 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3822.6661	16.4900	-630.3576
PV Unit electricity exported	-1446.7699	5.5900	-80.8744
Total			-711.2321 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	-1072.6622	5.5900	-59.9618
Total			-472.6865 (252)
Total energy cost			-334.9620 (255)

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11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.3030 (257)
SAP value		104.9108
SAP rating (Section 12)		105 (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	1669.3906	0.1574	262.7704 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1433.6022	0.1406	201.6336 (264)
Space and water heating			464.4040 (265)
Pumps, fans and electric keep-hot	1691.0450	0.1387	234.5688 (267)
Energy for lighting	354.2740	0.1443	51.1327 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3822.6661	0.1328	-507.5430
PV Unit electricity exported	-1446.7699	0.1186	-171.6082
Total			-679.1512 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	-1072.6622	0.1387	-148.7915
Total			-495.9716 (269)
Total CO2, kg/year			-425.0174 (272)
CO2 emissions per m2			-1.2000 (273)
EI value			101.4308
EI rating			101 (274)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	187.7400 (1b)	x 2.7000 (2b)	= 506.8980 (1b) - (3b)
First floor	165.3000 (1c)	x 3.9800 (2c)	= 657.8940 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	353.0400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1164.7920 (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	1 * 10 = 10.0000 (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)

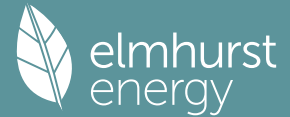
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0086 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		1.0000 (17)
Infiltration rate		0.0586 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0586 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.6000	6.2000	6.1000	5.6000	5.5000	4.7000	4.6000	4.5000	5.0000	5.8000	6.0000	6.5000 (22)
Wind factor	1.6500	1.5500	1.5250	1.4000	1.3750	1.1750	1.1500	1.1250	1.2500	1.4500	1.5000	1.6250 (22a)
Adj infiltr rate	0.0967	0.0908	0.0893	0.0820	0.0806	0.0688	0.0674	0.0659	0.0732	0.0849	0.0879	0.0952 (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)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1917	0.1858	0.1843	0.1770	0.1756	0.1638	0.1624	0.1609	0.1682	0.1799	0.1829	0.1902 (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
Opening Type 1 (Uw = 0.80)			76.7800	0.7752	59.5194		(27)
Opening Type 3			5.6600	1.0000	5.6600		(26a)
Dining			1.5000	0.9615	1.4423		(27a)

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Lounge				1.5000	0.9615	1.4423					(27a)
Stair				1.5000	0.9615	1.4423					(27a)
Heatloss Floor 1				187.7400	0.0800	15.0192	110.0000	20651.4000			(28a)
External Wall 1	427.0200	82.4400		344.5800	0.0900	31.0122	9.0000	3101.2200			(29a)
External Roof 1	245.2300	4.5000		240.7300	0.1000	24.0730	9.0000	2166.5700			(30)
External Roof 2	22.4400			22.4400	0.1000	2.2440	9.0000	201.9600			(30)
External Roof 3	43.4500			43.4500	0.1000	4.3450	9.0000	391.0500			(30)
Total net area of external elements Aum(A, m2)				925.8800							(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...	(30) + (32) =	146.1997					(33)
Internal Wall 1				100.0000			75.0000	7500.0000			(32c)
Internal Wall 2				145.0000			9.0000	1305.0000			(32c)
Internal Floor 1				165.3000			18.0000	2975.4000			(32d)
Internal Ceiling 1				169.1700			9.0000	1522.5300			(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 39815.1300 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 112.7780 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	48.5500	0.0700	3.3985	
E3 Sill	37.0000	0.0400	1.4800	
E4 Jamb	111.1000	0.0600	6.6660	
R1 Head of roof window	3.6000	0.2400	0.8640	
R2 Sill of roof window	3.6000	0.2400	0.8640	
R3 Jamb of roof window	7.8000	0.2400	1.8720	
E5 Ground floor (normal)	73.2500	0.0400	2.9300	
E6 Intermediate floor within a dwelling	58.7500	0.0700	4.1125	
E14 Flat roof	13.4000	0.1600	2.1440	
E16 Corner (normal)	53.3200	0.1800	9.5976	
E17 Corner (inverted - internal area greater than external area)	28.8400	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	54.2500	0.0400	2.1700	
E11 Eaves (insulation at rafter level)	31.3500	0.1500	4.7025	
E13 Gable (insulation at rafter level)	22.5000	0.2500	5.6250	
R4 Ridge (vaulted ceiling)	22.8000	0.1200	2.7360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 49.1621 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 195.3618 (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	
	73.6727	71.4208	70.8578	68.0429	67.4799	62.9761	62.4132	61.8502	64.6651	69.1689	70.2948	73.1097	(38)
Heat transfer coeff	269.0345	266.7826	266.2196	263.4047	262.8418	258.3379	257.7750	257.2120	260.0269	264.5307	265.6566	268.4715	(39)
Average = Sum(39)m / 12 =												263.3578	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.7621	0.7557	0.7541	0.7461	0.7445	0.7318	0.7302	0.7286	0.7365	0.7493	0.7525	0.7605	(40)
HLP (average)												0.7460	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.2009 (42)

Hot water usage for mixer showers	77.8882	76.7177	75.0120	71.7485	69.3402	66.6544	65.1278	66.8206	68.6761	71.5598	74.8934	77.5898	(42a)
Hot water usage for baths	33.6177	33.1184	32.4153	31.1190	30.1483	29.0720	28.4906	29.1887	29.9489	31.1006	32.4237	33.5040	(42b)
Hot water usage for other uses	47.4102	45.6862	43.9622	42.2382	40.5142	38.7902	38.7902	40.5142	42.2382	43.9622	45.6862	47.4102	(42c)
Average daily hot water use (litres/day)												146.0794	(43)

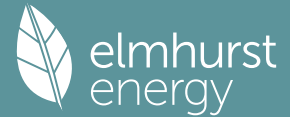
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	158.9161	155.5223	151.3896	145.1058	140.0027	134.5166	132.4086	136.5235	140.8632	146.6227	153.0033	158.5040	(44)	
Energy conte	251.6843	221.4617	232.6801	198.6425	188.4705	165.4038	160.1367	169.0446	173.6985	198.9656	217.9813	248.1790	(45)	
Energy content (annual)												Total = Sum(45)m =	2426.3486	
Distribution loss (46)m = 0.15 x (45)m	37.7526	33.2193	34.9020	29.7964	28.2706	24.8106	24.0205	25.3567	26.0548	29.8448	32.6972	37.2269	(46)	
Water storage loss:														
Store volume													300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):													1.7000 (48)	
Temperature factor from Table 2b													0.7930 (49)	
Enter (49) or (54) in (55)													1.3481 (55)	
Total storage loss	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	(56)	
If cylinder contains dedicated solar storage	41.7906	37.7463	41.7906	40.4425	41.7906	40.4425	41.7906	41.7906	40.4425	41.7906	40.4425	41.7906	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)	
Total heat required for water heating calculated for each month	316.7372	280.2192	297.7331	261.5970	253.5235	228.3583	225.1897	234.0976	236.6530	264.0186	280.9357	313.2320	(62)	
WWHRS	-52.0516	-46.0349	-48.2051	-39.9157	-37.2000	-31.8323	-29.8377	-31.7294	-32.9350	-38.8267	-43.9859	-51.0877	(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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443	(64)	
												Total per year (kWh/year) = Sum(64)m =	2708.6528 (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	135.7274	120.6420	129.4085	116.4122	114.7088	105.3604	105.2878	108.2497	108.1183	118.1984	122.8424	134.5619	(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	
	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	192.0529	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.1511	44.5438	36.2255	27.4250	20.5005	17.3074	18.7012	24.3086	32.6269	41.4274	48.3519	51.5450	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	746.1549	753.8976	734.3861	692.8485	640.4147	591.1343	558.2120	550.4692	569.9807	611.5183	663.9522	713.2325	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	57.4062	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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Losses e.g. evaporation (negative values) (Table 5)

	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	-128.0353	(71)
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Water heating gains (Table 5)

	182.4293	179.5268	173.9362	161.6837	154.1785	146.3338	141.5159	145.4969	150.1643	158.8689	170.6144	180.8628	(72)
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Total internal gains

	1100.1591	1099.3921	1065.9716	1003.3810	936.5175	876.1993	839.8529	841.6985	874.1958	933.2384	1004.3422	1067.0641	(73)
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6. Solar gains

[Jan]		Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast		36.5800	15.8649	0.6800	0.7000	1.0000	248.6163 (75)						
Southeast		11.8000	48.0626	0.6800	0.7000	1.0000	242.9622 (77)						
Southwest		14.5500	48.0626	0.6800	0.7000	1.0000	299.5847 (79)						
Northwest		13.8500	15.8649	0.6800	0.7000	1.0000	94.1317 (81)						
Northeast		3.0000	25.7636	0.6800	0.7000	1.0000	40.3319 (82)						
Southeast		1.5000	50.6482	0.6800	0.7000	1.0000	32.5465 (82)						
Solar gains	958.1733	1527.2364	2373.8633	3524.7774	4169.5614	4714.7343	4031.3560	3661.5446	2877.4541	1829.1915	1125.1986	779.0702	(83)
Total gains	2058.3325	2626.6285	3439.8349	4528.1584	5106.0790	5590.9337	4871.2089	4503.2431	3751.6499	2762.4299	2129.5409	1846.1344	(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	41.1091	41.4561	41.5437	41.9877	42.0776	42.8112	42.9047	42.9986	42.5331	41.8090	41.6318	41.1953
alpha	3.7406	3.7637	3.7696	3.7992	3.8052	3.8541	3.8603	3.8666	3.8355	3.7873	3.7755	3.7464
util living area	0.9498	0.8977	0.7897	0.6086	0.4496	0.2983	0.2531	0.2672	0.4200	0.7084	0.8992	0.9583 (86)
Living	19.8898	20.2031	20.5588	20.8478	20.9570	20.9929	20.9971	20.9966	20.9773	20.8042	20.3477	19.8787
Non living	19.0000	19.3894	19.8135	20.1454	20.2621	20.3074	20.3124	20.3135	20.2910	20.1081	19.5767	18.9891
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.4321	20.2031	20.5588	20.8478	20.9570	20.9929	20.9971	20.9966	20.9773	20.8042	20.3477	20.0355 (87)
Th 2	20.2863	20.2919	20.2933	20.3003	20.3017	20.3129	20.3143	20.3157	20.3087	20.2975	20.2947	20.2877 (88)
util rest of house	0.9419	0.8837	0.7668	0.5792	0.4175	0.2674	0.2172	0.2288	0.3759	0.6695	0.8820	0.9512 (89)
MIT 2	19.7735	19.3894	19.8135	20.1454	20.2621	20.3074	20.3124	20.3135	20.2910	20.1081	19.5767	19.2231 (90)
Living area fraction									fLA = Living area / (4) =			0.2124 (91)
MIT	19.9134	19.5622	19.9718	20.2946	20.4097	20.4530	20.4579	20.4586	20.4368	20.2560	19.7405	19.3957 (92)
Temperature adjustment												-0.1000
adjusted MIT	19.8134	19.4622	19.8718	20.1946	20.3097	20.3530	20.3579	20.3586	20.3368	20.1560	19.6405	19.2957 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9359	0.8645	0.7521	0.5746	0.4179	0.2692	0.2195	0.2312	0.3777	0.6611	0.8631	0.9387 (94)
Useful gains	1926.3861	2270.6936	2586.9417	2601.9338	2133.9194	1504.8959	1069.3767	1041.1150	1416.9719	1826.3135	1837.9918	1733.0313 (95)
Ext temp.	7.0000	7.3000	8.1000	9.6000	12.0000	14.5000	16.2000	16.3000	14.8000	12.4000	9.8000	7.6000 (96)
Heat loss rate W	3447.2505	3244.6736	3133.8929	2790.6707	2184.1410	1512.0504	1071.7990	1043.9320	1439.7180	2051.6950	2614.1961	3139.9613 (97)
Space heating kWh	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559 (98a)
Space heating requirement - total per year (kWh/year)												4139.5316
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	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4139.5316
Space heating per m ²										(98c) / (4) =		11.7254 (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 %) 383.6166 (206)

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

Efficiency of secondary/supplementary heating system, % 60.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1131.5231	654.5145	406.9317	135.8906	37.3649	0.0000	0.0000	0.0000	0.0000	167.6838	558.8671	1046.7559 (98)
Space heating efficiency (main heating system 1)	383.6166	383.6166	383.6166	383.6166	383.6166	0.0000	0.0000	0.0000	0.0000	383.6166	383.6166	383.6166 (210)
Space heating fuel (main heating system)	294.9620	170.6169	106.0777	35.4235	9.7402	0.0000	0.0000	0.0000	0.0000	43.7113	145.6838	272.8651 (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	264.6856	234.1843	249.5280	221.6813	216.3235	196.5260	195.3519	202.3681	203.7180	225.1919	236.9498	262.1443 (64)
Efficiency of water heater (217)m	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559	188.9559 (216)
Fuel for water heating, kWh/month	140.0780	123.9360	132.0562	117.3190	114.4836	104.0063	103.3849	107.0981	107.8124	119.1769	125.3995	138.7330 (219)
Space cooling fuel requirement												

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(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	143.6230	129.7240	143.6230	138.9900	143.6230	138.9900	143.6230	143.6230	138.9900	143.6230	138.9900	143.6230	143.6230	(231)
Lighting	43.8970	35.2158	31.7079	23.2306	17.9440	14.6604	16.3691	21.2772	27.6369	36.2612	40.9569	45.1170	45.1170	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-178.1530	-248.1262	-391.8206	-477.8629	-516.2077	-509.1035	-478.9106	-462.2022	-399.0052	-306.4661	-197.5805	-145.1830	-145.1830	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-14.7800	-36.9074	-103.6398	-219.1874	-310.1908	-380.8554	-312.9937	-276.8477	-179.2122	-74.3284	-23.6489	-10.1272	-10.1272	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-91.1028	-88.1640	-91.1028	-88.1640	-91.1028	-91.1028	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													1079.0805	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													188.9559	
Water heating fuel used													1433.4839	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900)														
mechanical ventilation fans (SFP = 1.1900)													1691.0450	(230a)
Total electricity for the above, kWh/year													1691.0450	(231)
Electricity for lighting (calculated in Appendix L)													354.2740	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-6253.3404	(233)
Wind generation													-3575.5408	(234)
Hydro-electric generation (Appendix N)													0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(235)
Appendix Q - special features														
Energy saved or generated													-0.0000	(236)
Energy used													0.0000	(237)
Total delivered energy for all uses													-5270.9977	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1079.0805	21.5100	232.1102	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1433.4839	21.5100	308.3424	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	1691.0450	21.5100	363.7438	(249)
Energy for lighting	354.2740	21.5100	76.2043	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4310.6215	21.5100	-927.2147	
PV Unit electricity exported	-1942.7189	5.5900	-108.5980	
Total			-1035.8127	(252)
Wind Turbine electricity used in dwelling	-2502.8785	21.5100	-538.3692	
Wind Turbine electricity exported	-1072.6622	5.5900	-59.9618	
Total			-598.3310	(252)
Total energy cost			-653.7429	(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	1079.0805	0.1579	170.3787	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1433.4839	0.1406	201.6170	(264)
Space and water heating			371.9956	(265)
Pumps, fans and electric keep-hot	1691.0450	0.1387	234.5688	(267)
Energy for lighting	354.2740	0.1443	51.1327	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4310.6215	0.1334	-575.0371	
PV Unit electricity exported	-1942.7189	0.1197	-232.4719	
Total			-807.5090	(269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801	
Wind Turbine electricity exported	-1072.6622	0.1387	-148.7915	
Total			-495.9716	(269)
Total CO2, kg/year			-645.7835	(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	1079.0805	1.5844	1709.7261	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1433.4839	1.5201	2178.9721	(278)
Space and water heating			3888.6982	(279)
Pumps, fans and electric keep-hot	1691.0450	1.5128	2558.2129	(281)
Energy for lighting	354.2740	1.5338	543.3972	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-4310.6215	1.4929	-6435.5332	
PV Unit electricity exported	-1942.7189	0.4390	-852.8678	
Total			-7288.4010	(283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546	
Wind Turbine electricity exported	-1072.6622	0.5128	-550.0612	
Total			-4336.4158	(283)

Total Primary energy kWh/year

-4634.5085 (286)