



**FALCON
ENERGY
LIMITED**

Energy Conservation Specialists

**25 Warren Road
Ickenham**

Energy Statement

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Report By: Neil Vanson

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**25 Warren Road, Ickenham UB10 8AA
Energy Statement**



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Disclaimer

This report is for the use of the client only and is not for the use of any other parties without the express permission of the client. All energy calculations, related quantified predictions and the code for sustainable homes pre-assessment are indicative for planning and are based solely on the available design proposals and must be reassessed during detailed design with the appropriate compliance methodology.



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1. Executive Summary

The proposed new build development at 25 Warren Road is a residential development comprising of 1 no new build detached house.

Planning Condition 7

Prior to the commencement of the development hereby approved, a sustainability and energy statement shall be submitted to and approved in writing by the Local Planning Authority. The sustainability and energy statement shall demonstrate how a 10% reduction in carbon dioxide emissions beyond Building Regulations Part L 2013 (TER Baseline) has been achieved including full technology specifications and locations. Thereafter, the development shall be carried out in accordance with the approved details.

REASON

To ensure the development contributes to minimising the effects of, and can adapt to a changing climate in accordance with Policies DMEI 2 and DMEI 10 of the Hillingdon Local Plan Part 2 (2020).and Policy SI 2 of the London Plan (2021).

An energy efficient scheme has been proposed that has reduced the CO2 emissions through passive design measures, increasing insulation in the building fabric to reduce heat loss, improved heating and lighting systems and controls. These measures have resulted in predicted CO2 emissions that are achieving Part L 2013 baseline requirement.

To meet the 10% reduction in CO2 emissions over the baseline a total of 10 sqm of photovoltaic (PV) panels at an inclination of 30 degrees shall be provided to the house with ASHP serving Under floor heating.

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2.0 Introduction

The proposed new build development is a residential development comprising of 1 no new build house.

The development has been evaluated, following the Energy Hierarchy to ensure the development is energy efficient and achieves the London Borough of Hillingdon's target of a 10% reduction in carbon dioxide emissions beyond Building Regulations 2013.



Figure 1, Location plan

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3.0 Planning Policy

The London Plan Spatial Development Strategy for Greater London, July 2011, in Chapter 5 London's Response to Climate Change, requires in Policy 5.2 for all buildings to reduce their carbon dioxide emissions beyond building regulations, following the Energy Hierarchy:

Be lean: use less energy

Be clean: supply energy efficiently

Be green: use renewable energy

The London Plan includes strategic targets for carbon dioxide reduction to enable the Mayors Climate Change Mitigation targets to be met (Policy 5.1). The current target requirement is to reduce carbon dioxide emissions by 35% beyond Building Regulations Part L 2013.

Residential buildings:		Non-domestic buildings:	
Year	Improvement on 2010 Building Regulations	Year	Improvement on 2010 Building Regulations
2010 – 2013	25 per cent (Code for Sustainable Homes level 4)	2010 – 2013	25 per cent
2013 – 2016	40 per cent	2013 – 2016	40 per cent
2016 – 2031	Zero carbon	2016 – 2019	As per building regulations requirements
		2019 – 2031	Zero carbon

4.0 Design targets

The Energy Assessment shall demonstrate how the proposed development shall meet the targets of both the Local Plan of Hillingdon Council and the London Plan. The requirements are:

10% improvement on Building Regulations 2013

5.0 Baseline SAPs

To determine the baseline CO₂ emissions for the development the following was undertaken for the Houses within the proposed scheme.

SAP calculations demonstrating compliance with Part L 2013 were undertaken on the dwelling.

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Baseline Assessment Results

Baseline	CO2 per year t/yr
Residential House	
1	1.19
Total	1.19 t/yr

6.0 Be Lean-Energy Efficient Scheme

The first step of the energy hierarchy is to improve the design of the building fabric and services to maximise the energy efficiency and minimise the energy requirements.

To reduce the CO2 emissions from the residential flats and houses, the following improvements were made to the building design.

The heat loss from the dwellings have been reduced by increasing the levels of insulation in the building fabric to achieve U-values significantly better than Part L 2013 performance standards, shown in Table 6.1. This shall reduce the energy requirement for heating and therefore the energy consumption and CO2 emissions associated with the heating.

	Target U Value W/M ² K	2013 Limiting Fabric Parameters	
External Walls	0.18	0.30	
Roof	0.14	0.20	
Floor	0.13	0.25	
Glazing (including roof lights)	1.20	2.0	
Air Permeability	5.0	10.0	

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Table 6.1

Natural ventilation shall be maintained for the dwelling with energy efficient extract provided to the kitchen and bathrooms only. This shall have very low specific fan powers and shall only operate when the kitchen or bathroom is occupied, to minimise energy consumption.

100% energy efficient lighting will be installed throughout. The lighting will in the common ways shall be controlled via PIR sensors to enable the lighting to only be switched on in areas where it is required. This shall enable the energy consumption associated with lighting to remain as low as practicable.

Energy display devices shall be provided to each dwelling to enable occupants to review and understand their energy consumption and therefore take steps to minimise energy in use of the dwelling. The energy display devices shall measure and transmit energy consumption data to a visual display unit. The visual display unit shall display the following information as a minimum:

- Local time
- Current mains energy consumption (kilowatts and kilowatt hours)
- Current emissions (g/kg CO₂)
- Current tariff
- Current cost
- Display accurate account balance information (amount in credit or debit)
- Visual presentation of data (i.e. non-numeric) to allow consumers to easily identify high and low level of usage
- Historical consumption data

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7.0 Be Lean Assessment Results

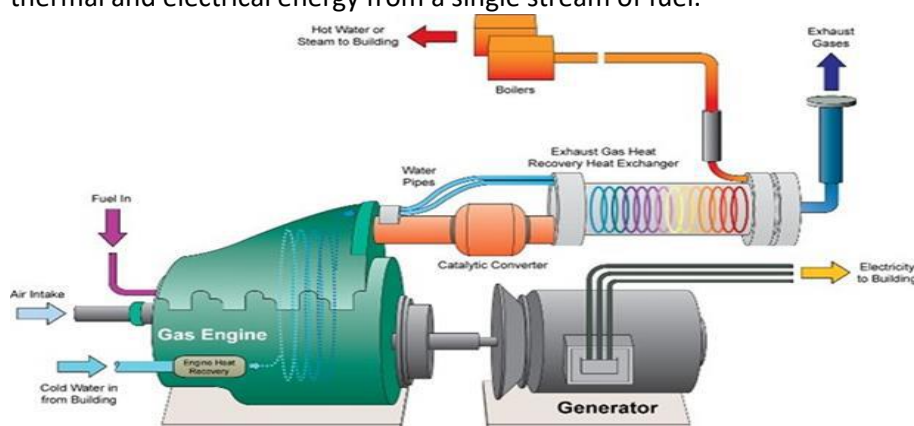
The energy demand and resulting CO2 emissions for the energy efficient Be Lean scheme are presented in Table 6.2 and show the CO2 emissions are the same.

Be Lean Assessment Results

Be Lean	CO2 per year t/yr
Residential House	
1	1.19
Total	1.19 t/yr

8.0 Be Clean

Combined heat and power (CHP), also known as cogeneration, is the simultaneous generation of thermal and electrical energy from a single stream of fuel.



CHP installations can typically convert between 80% and 90% of the energy in the fuel into electrical power and useful heat. By generating the electricity in an on-site CHP unit, and utilizing the heat, electricity from conventional power stations is displaced and the substantial conversion, transmission and distribution losses are avoided. The resulting efficiency gives typical small-scale CHP installations a simple payback period of between 3 and 5 years, beyond which the units continue to save energy right up until the end of the life of the plant.

Systems must be 'heat lead' for high efficiency, which best suits applications to situations where there is a significant demand for heat for long periods of time, such as hospitals, hotels and leisure centres. Due to the nature and limited size of this residential scheme, CHP would not be applicable as there is not a constant heat requirement. It is likely there will be a small number of peak demands, e.g. between 6am – 7.30am as residents shower in the morning, rather than a steady load throughout the day.

In the London Plan Policy 5.5 Decentralised Energy Networks, the Mayor expects 25% of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025.

Plans show there are no existing district heating networks that the proposed scheme could connect to.

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Therefore CHP either on-site or via an existing network is not a viable solution for this residential scheme.

9.0 Be Green use of renewable energy

The following low and zero carbon technologies have been considered for the scheme:

10.0 Ground Source Heat Pumps

A ground sourced heat pump (GSHP) is a device for extracting heat from the ground to provide space heating and domestic hot water for buildings. Water or another fluid is circulated through pipes buried in the ground and passes through a heat exchanger in the heat pump that extracts heat from the fluid. The heat pump then raises the temperature of the fluid via the compression cycle to supply hot water to the building as from a normal boiler.

Providing the space heating requirement only using ground source heat pumps would provide 17.8% CO₂ reduction over the lean building. This would require approximately 16 boreholes across the site, spaced between 25m to 50m centres, or horizontal coils would require an area of approximately 3,400m².

Using GSHP for 100% of the space heating will only provide a 21.8% reduction in predicted CO₂ emissions, due to the high CO₂ emissions associated with grid supplied electricity. This is an expensive technology with low CO₂ reductions that will not meet the London Plan requirements without additional LZC technologies. **Therefore this is not considered to be viable for this project.**

11.0 Air Source Heat Pumps

Air Source Heat Pumps extract heat from the outside air through a using an external condenser unit and transfers it, through refrigeration pipework to the indoor unit which then conveys that heat to the heating emitters and hot water cylinder. This system is capable of providing 100% of heating within a building. **This technology was viable and will do 100% of the heating.**

Providing air source heat pumps to the building for the space heating would reduce the carbon dioxide emissions by 16.8% from the Lean building.

This system would require one external condenser unit to be located external to the building, which would not have space and noise implications. **This technology is considered viable.**

12.0 Biomass

Waste timber, in the form of wood chips and pellets, is used as fuel in boilers providing heating to buildings. Biomass generates about the same amount of carbon dioxide as fossil fuels, however, with new plant/tree growth this carbon dioxide is actually removed from the atmosphere making the Biomass system carbon neutral. Wood chips and pellets present no risk if accidentally released into the environment and there are no harmful by-products. The flue gas is smoke-free and the ash content of between 0.5% and 3% by volume (depending on material), is minimal.

When sizing biomass is standard practice the biomass boilers would meet a significant proportion of the heating load and gas condensing boilers would assist with providing load trimming to reduce the amount of on/off cycling of the biomass boilers. The provision of biomass boilers to meet all the

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domestic hot water demand and 30% of the annual energy demand for space heating only would reduce the carbon emissions of the building by 40%.

The provision of biomass boilers for this site would require a central energy centre to be provided sized to allow for at least one biomass boiler and gas backup boiler(s). The number of boilers would be dependent upon detailed analysis of the demand load profiles during detail design stage. Storage of the biomass fuel is required on site, sized to accommodate at least one peak month of heating. Based on the predicted domestic hot water and 30% heating requirements, this would require 30m³ storage for wood pellets or 135m³ of woodchip, depending upon the boiler selection. The store would need to be easily accessed by a large delivery vehicle, similarly sized to a petrol tanker and therefore there may be issues surrounding vehicular access to the site.

The space and access requirements for the energy centre and biomass store are **unlikely to be viable on this site**. Furthermore, the biomass boiler(s) would require a large flue and careful consideration of its sizing, location and the potential impact of local air quality would be required in this residential area.

13.0 Solar thermal

Solar water heating systems use the energy from the sun to heat water, most commonly in the UK for hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is passed through a heat exchanger and used to heat up water which is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building. There are two types of collectors used for solar water heating applications - flat plate collectors and evacuated tube collectors. Evacuated tube collectors are generally more expensive due to a more complex manufacturing process (to achieve the vacuum) but manufacturers generally claim better winter performance.

A 31m² solar thermal collector array would provide 50% of the annual hot water demand on site, which would provide a 9.9% reduction in CO₂ emissions from the Lean dwellings. This is a small reduction for the relatively high capital cost, and to meet the London Plan targets an additional technology would be required. Thermal collectors would also need to be located on the roof of the houses, reducing the area available for PV, which has a greater impact on CO₂ emissions per square metre. **This was not felt viable.**

14.0 Photovoltaics

Solar photovoltaic (PV) technology is a semi-conductor based technology that converts the energy in sunlight into electricity. The term describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load. The PV systems should be unshaded. Shading even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid; and feed-in tariffs are available. The site can have 7 panels which is 2.73 kWp with a 3 kWp battery and will hit the 10% reduction **this was felt viable.**

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Be Green Assessment Results

Be Green	CO2 per year t/yr
Residential Houses	
1	0.93
Total	0.93 t/yr

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15.0 Summary of CO2 Emission Reduction for Scheme

The energy strategy for the proposed development scheme has been assessed using the Energy Hierarchy:

Be Lean: use less energy

Be Clean: supply energy efficiently

Be Green: use renewable energy

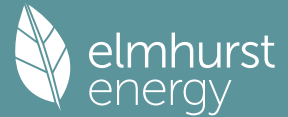
	CO2 Emissions t/yr	CO2 Reduction	Reductions at each stage	Reduction from Baseline
Baseline	1.19	-	-	-
Be lean	1.19	0	0%	0%
Be Green	0.93	0.26	21.84%	21.84%



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SAP Worksheets

Full SAP Calculation Printout



Property Reference	UB10 8AA				Issued on Date	13/04/2023
Assessment Reference	00001	Prop Type Ref				
Property	25, Warren Road, Ickenham, UB10 8AA					
SAP Rating	82 B	DER	3.06	TER	7.02	
Environmental	96 A	% DER < TER				56.41
CO ₂ Emissions (t/year)	1.19	DFEE	35.86	TFEE	39.26	
Compliance Check	See BREL	% DFEE < TFEE				8.65
% DPER < TPER	15.79	DPER	31.78	TPER	37.74	
Assessor Details	Mr. Neil Vanson				Assessor ID	M057-0001
Client						

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	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	8 * 10 = 80.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

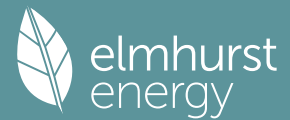
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.0714 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3214	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210 (22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515 (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 = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	1.1450	6.8702		(27a)
Opening			3.0000	1.1450	3.4351		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000 (28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000 (29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000 (29a)

Full SAP Calculation Printout



External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100 (29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700 (30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900 (30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000 (30)
Total net area of external elements Aum(A, m2)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100 (32c)
Internal Floor 1			132.1200			18.0000	2378.1600 (32d)
Internal Floor 2			84.2400			18.0000	1516.3200 (32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400 (32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998
E3 Sill	33.3000	0.0190	0.6327
E4 Jamb	55.4000	0.0060	0.3324
E5 Ground floor (normal)	59.7000	0.0930	5.5521
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000
E16 Corner (normal)	42.0000	0.0350	1.4700
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5070 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 189.3669 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	207.2426	206.3718	205.5182	201.5089	200.7588	197.2669	197.2669	196.6202	198.6119	200.7588	202.2763	203.8627	(38)
Average = Sum(39)m / 12 =	396.6095	395.7387	394.8851	390.8759	390.1258	386.6338	386.6338	385.9872	387.9789	390.1258	391.6432	393.2297	(39)
													390.8723

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9239	0.9218	0.9198	0.9105	0.9087	0.9006	0.9006	0.8991	0.9037	0.9087	0.9123	0.9160	(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													3.3000 (42)
Hot water usage for mixer showers	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)
Hot water usage for baths	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	(42b)
Hot water usage for other uses	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	(42c)
Average daily hot water use (litres/day)													153.1900 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372	(44)
Energy content (annual)	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2544.4469

Distribution loss (46)m = 0.15 x (45)m	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431	(46)
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Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)

Temperature factor from Table 2b 0.7800 (49)

Enter (49) or (54) in (55) 1.4820 (55)

Total storage loss

45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	(56)
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45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	(57)
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Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
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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

364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	361.0868	(62)
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WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
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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)
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Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
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FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
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Output from w/h	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
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Total per year (kWh/year) = Sum(64)m = 3606.9385 (64)

12Total per year (kWh/year) 3607 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

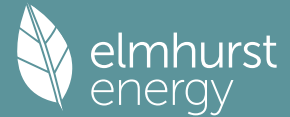
131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316	130.4316	(65)
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

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

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(66)m	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains	1099.4122	1133.6009	1081.7031	1047.6958	990.9474	921.8110	882.4412	880.8548	910.0949	974.3620	1035.5490	1073.2344	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				34.6500	10.6334		0.7600		0.7000		0.7700		135.8376 (74)
South				21.8400	46.7521		0.7600		0.7000		0.7700		376.4422 (78)
East				3.0000	25.9287		0.7600		0.7000		1.0000		37.2440 (82)
South				6.0000	26.0000		0.7600		0.7000		1.0000		74.6928 (82)
Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912	(83)
Total gains	1723.6288	2239.3551	2710.8857	3266.7250	3663.3750	3658.2108	3485.8787	3132.5919	2741.0513	2227.4692	1790.8706	1602.5255	(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	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881		
alpha	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592		
util living area	0.9989	0.9959	0.9857	0.9427	0.8262	0.6410	0.4806	0.5513	0.8209	0.9752	0.9970	0.9992	(86)	
Living	19.7466	19.9307	20.1945	20.5350	20.7902	20.9055	20.9308	20.9254	20.8329	20.4777	20.0465	19.7197		
Non living	18.6441	18.8810	19.2183	19.6488	19.9452	20.0650	20.0836	20.0821	20.0006	19.5858	19.0360	18.6147		
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0		
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31		
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0		
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)	
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539	(88)	
util rest of house	0.9986	0.9948	0.9819	0.9272	0.7842	0.5698	0.3931	0.4586	0.7618	0.9660	0.9961	0.9990	(89)	
MIT 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539	(90)	
Living area fraction									flA = Living area / (4) =			0.2182	(91)	
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386	(92)	
Temperature adjustment												0.0000		
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386	(93)	

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9987	0.9950	0.9828	0.9310	0.7941	0.5860	0.4125	0.4794	0.7760	0.9683	0.9963	0.9991	(94)
Useful gains	1721.3215	2228.2344	2664.2611	3041.2286	2908.9817	2143.5665	1438.0954	1501.7929	2126.9480	2156.8506	1784.2793	1601.0322	(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	6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)
Space heating kWh	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98a)
Space heating requirement - total per year (kWh/year)												16718.1923	
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	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16718.1923	
Space heating per m2										(98c) / (4) =		38.9429	(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 %)	332.9430	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98)
Space heating efficiency (main heating system 1)	332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)	1036.3390	783.0991	625.5526	309.5125	103.4659	0.0000	0.0000	0.0000	0.0000	367.4344	735.5796	1060.3547	(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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260	(217)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												5021.3378	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												3140.8381	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												615.5363	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												8777.7122	(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	5021.3378	0.1557	781.7279 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1226.1910 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Total CO2, kg/year			1315.0319 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0600 (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	5021.3378	1.5764	7915.4296 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	1.5233	4784.4360 (278)
Space and water heating			12699.8657 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Total Primary energy kWh/year			13643.9958 (286)
Dwelling Primary energy Rate (DPER)			31.7800 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.0357 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2857 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2429 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3096	0.3036	0.2975	0.2671	0.2611	0.2307	0.2307	0.2246	0.2429	0.2611	0.2732	0.2854 (22b)
Effective ac	0.5479	0.5461	0.5443	0.5357	0.5341	0.5266	0.5266	0.5252	0.5295	0.5341	0.5373	0.5407 (25)

3. Heat losses and heat loss parameter

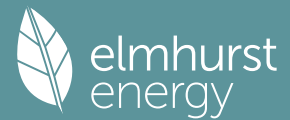
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opening Type (Uw = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	2.0221	12.1324		(27a)
Opening			3.0000	1.8519	5.5556		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496		(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408		(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942		(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782		(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1100	3.0613		(30)
External Roof 2	61.9100		61.9100	0.1100	6.8101		(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450		(30)
Total net area of external elements Aum(A, m ²)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	181.5503		(33)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	33.3000	0.0500	1.6650
E3 Sill	33.3000	0.0500	1.6650
E4 Jamb	55.4000	0.0500	2.7700
E5 Ground floor (normal)	59.7000	0.1600	9.5520
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000
E16 Corner (normal)	42.0000	0.0900	3.7800
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			20.8720 (36)

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Point Thermal bridges
Total fabric heat loss (33) + (36) + (36a) = 0.0000
202.4223 (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 202.5362 201.8481 201.1737 198.0058 197.4131 194.6540 194.6540 194.1431 195.7168 197.4131 198.6122 199.8657 (38)
Heat transfer coeff 404.9585 404.2705 403.5960 400.4281 399.8354 397.0763 397.0763 396.5654 398.1391 399.8354 401.0345 402.2880 (39)
Average = Sum(39)m / 12 = 400.4253

HLP Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
HLP (average) 0.9433 0.9417 0.9401 0.9327 0.9314 0.9249 0.9249 0.9237 0.9274 0.9314 0.9342 0.9371 (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 3.3000 (42)
Hot water usage for mixer showers 79.5504 78.3549 76.6129 73.2798 70.8200 68.0769 66.5177 68.2466 70.1418 73.0870 76.4917 79.2456 (42a)
Hot water usage for baths 34.3325 33.8226 33.1046 31.7807 30.7894 29.6901 29.0964 29.8094 30.5857 31.7619 33.1131 34.2164 (42b)
Hot water usage for other uses 48.4255 46.6646 44.9036 43.1427 41.3818 39.6209 39.6209 41.3818 43.1427 44.9036 46.6646 48.4255 (42c)
Average daily hot water use (litres/day) 149.1977 (43)
Daily hot water use Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
162.3084 158.8421 154.6211 148.2032 142.9912 137.3879 135.2350 139.4378 143.8702 149.7526 156.2694 161.8876 (44)
Energy conte 257.0569 226.1891 237.6469 202.8827 192.4936 168.9345 163.5550 172.6531 177.4064 203.2129 222.6344 253.4768 (45)
Energy content (annual) Total = Sum(45)m = 2478.1423
Distribution loss (46)m = 0.15 x (45)m 38.5585 33.9284 35.6470 30.4324 28.8740 25.3402 24.5332 25.8980 26.6110 30.4819 33.3952 38.0215 (46)
Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss 28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (56)
If cylinder contains dedicated solar storage 28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)
Total heat required for water heating calculated for each month 308.8035 272.9280 289.3935 252.9601 244.2402 219.0118 215.3016 224.3997 227.4837 254.9595 272.7118 305.2234 (62)
WWHRS -36.3671 -32.1634 -33.6797 -27.8881 -25.9907 -22.2404 -20.8468 -22.1685 -23.0108 -27.1272 -30.7318 -35.6937 (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 272.4364 240.7646 255.7139 225.0720 218.2495 196.7714 194.4547 202.2312 204.4729 227.8323 241.9800 269.5298 (64)
Total per year (kWh/year) = Sum(64)m = 2749.5085 (64)
2750 (64)
12Total per year (kWh/year)
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 126.8687 112.5990 120.4149 107.5204 105.4014 96.2326 95.7793 98.8044 99.0495 108.9656 114.0878 125.6783 (65)

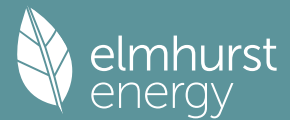
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
(66)m 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 165.0010 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 293.8168 325.2972 293.8168 303.6107 293.8168 303.6107 293.8168 293.8168 303.6107 293.8168 303.6107 293.8168 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 556.1445 561.9156 547.3727 516.4128 477.3314 440.6003 416.0618 410.2907 424.8336 455.7935 494.8749 531.6060 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 39.5001 (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) -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 -132.0008 (71)
Water heating gains (Table 5) 170.5224 167.5580 161.8479 149.3339 141.6685 133.6564 128.7356 132.8017 137.5687 146.4591 158.4553 168.9225 (72)
Total internal gains 1095.9841 1130.2710 1078.5378 1044.8577 988.3170 950.3677 911.1145 909.4095 938.5133 971.5697 1032.4413 1069.8456 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
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North	34.6500	10.6334	0.6300	0.7000	0.7700	112.6022 (74)
South	21.8400	46.7521	0.6300	0.7000	0.7700	312.0508 (78)
East	3.0000	25.9287	0.6300	0.7000	1.0000	30.8733 (82)
South	6.0000	26.0000	0.6300	0.7000	1.0000	61.9164 (82)

Solar gains	517.4427	916.6120	1350.5066	1839.4584	2215.3018	2268.3314	2158.1127	1866.5716	1517.7665	1038.7599	626.1219	438.7545 (83)
Total gains	1613.4268	2046.8831	2429.0445	2884.3161	3203.6188	3218.6991	3069.2272	2775.9811	2456.2799	2010.3297	1658.5632	1508.6001 (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	56.2115	56.3072	56.4013	56.8475	56.9317	57.3273	57.3273	57.4012	57.1743	56.9317	56.7615	56.5847
alpha	4.7474	4.7538	4.7601	4.7898	4.7954	4.8218	4.8218	4.8267	4.8116	4.7954	4.7841	4.7723
util living area	0.9992	0.9972	0.9910	0.9645	0.8829	0.7184	0.5524	0.6246	0.8708	0.9839	0.9979	0.9994 (86)
MIT	19.3414	19.5608	19.8899	20.3339	20.7126	20.9259	20.9833	20.9708	20.8034	20.2959	19.7352	19.3067 (87)
Th 2	20.1309	20.1322	20.1335	20.1398	20.1409	20.1464	20.1464	20.1474	20.1443	20.1409	20.1386	20.1361 (88)
util rest of house	0.9989	0.9964	0.9885	0.9539	0.8483	0.6453	0.4529	0.5228	0.8193	0.9775	0.9972	0.9992 (89)
MIT 2	18.1478	18.4298	18.8511	19.4151	19.8685	20.0943	20.1389	20.1329	19.9809	19.3745	18.6582	18.1070 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.4083	18.6766	19.0778	19.6156	20.0527	20.2758	20.3231	20.3158	20.1604	19.5756	18.8932	18.3688 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4083	18.6766	19.0778	19.6156	20.0527	20.2758	20.3231	20.3158	20.1604	19.5756	18.8932	18.3688 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9982	0.9946	0.9842	0.9456	0.8442	0.6571	0.4742	0.5439	0.8205	0.9717	0.9957	0.9987 (94)
Useful gains	1610.5629	2035.7420	2390.5693	2727.5294	2704.4879	2115.1480	1455.4172	1509.9618	2015.2944	1953.4411	1651.3844	1506.6492 (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	5713.2594	5569.4830	5076.3330	4290.8179	3339.7014	2253.7264	1478.3739	1552.8606	2412.8657	3588.7489	4729.4715	5699.9279 (97)
Space heating kWh	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (98a)
Space heating requirement - total per year (kWh/year)	15576.1459											
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	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	15576.1459											
Space heating per m2	(98c) / (4) = 36.2827 (99)											

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (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)	3307.0489	2572.7778	2164.9059	1219.4667	512.0248	0.0000	0.0000	0.0000	0.0000	1318.1680	2401.1080	3380.0643 (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	272.4364	240.7646	255.7139	225.0720	218.2495	196.7714	194.4547	202.2312	204.4729	227.8323	241.9800	269.5298 (64)
Efficiency of water heater (217)m	87.9869	87.8875	87.6781	87.1619	85.7449	79.8000	79.8000	79.8000	79.8000	87.2480	87.8250	79.8000 (216)
Fuel for water heating, kWh/month	309.6329	273.9462	291.6507	258.2230	254.5333	246.5807	243.6776	253.4225	256.2317	261.1318	275.5253	306.2467 (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	61.0493	48.9760	44.0975	32.3077	24.9554	20.3888	22.7652	29.5910	38.4358	50.4299	56.9604	62.7461 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-153.0179	-199.7273	-265.7745	-275.5410	-278.3352	-252.7080	-248.8595	-243.2998	-232.0257	-215.7896	-162.0698	-134.1792 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-142.6327	-291.1493	-563.3879	-825.3329	-1072.3773	-1071.3485	-1059.3576	-905.9846	-675.9247	-409.8952	-188.1315	-113.5524	(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												16875.5644	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3230.8025	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												492.7031	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-9980.4019	(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												10704.6681	(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	16875.5644	0.2100	3543.8685	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3230.8025	0.2100	678.4685	(264)
Space and water heating			4222.3370	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	492.7031	0.1443	71.1123	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2661.3275	0.1364	-362.9006	
PV Unit electricity exported	-7319.0744	0.1266	-926.8416	
Total			-1289.7422	(269)
Total CO2, kg/year			3015.6364	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.0200	(273)

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

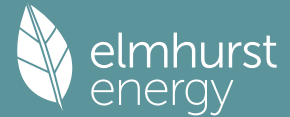
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	16875.5644	1.1300	19069.3878	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3230.8025	1.1300	3650.8068	(278)
Space and water heating			22720.1946	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	492.7031	1.5338	755.7245	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2661.3275	1.5041	-4002.8045	
PV Unit electricity exported	-7319.0744	0.4649	-3402.3744	
Total			-7405.1789	(283)
Total Primary energy kWh/year			16200.8409	(286)
Target Primary Energy Rate (TPER)			37.7400	(287)

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

1. Overall dwelling characteristics

Area Storey height Volume

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Ground floor	(m2)	x	(m)	=	(m3)	
First floor	201.9200 (1b)	x	2.5400 (2b)	=	512.8768 (1b)	-
Second floor	139.8000 (1c)	x	2.8400 (2c)	=	397.0320 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800 (1d)	x	2.4000 (2d)	=	210.1920 (1d)	-
Dwelling volume	429.3000				(4)	
					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008 (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) =												Air changes per hour
Pressure test													40.0000 / (5) = 0.0357 (8)
Pressure Test Method													Yes
Measured/design AP50													Blower Door
Infiltration rate													5.0000 (17)
Number of sides sheltered													0.2857 (18)
													2 (19)
Shelter factor													(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) = 0.2429 (21)

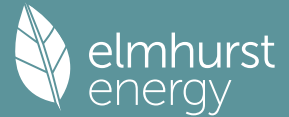
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
	0.3096	0.3036	0.2975	0.2671	0.2611	0.2307	0.2307	0.2246	0.2429	0.2611	0.2732	0.2854	(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	0.5479	0.5461	0.5443	0.5357	0.5341	0.5266	0.5266	0.5252	0.5295	0.5341	0.5373	0.5407	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)
Heat capacity Cm = Sum(A x k)								
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								(28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)
List of Thermal Bridges								190.8874 (35)
K1 Element				Length	Psi-value		Total	
E2 Other lintels (including other steel lintels)				33.3000	0.0060		0.1998	
E3 Sill				33.3000	0.0190		0.6327	
E4 Jamb				55.4000	0.0060		0.3324	
E5 Ground floor (normal)				59.7000	0.0930		5.5521	
E6 Intermediate floor within a dwelling				49.7900	0.0000		0.0000	
E16 Corner (normal)				42.0000	0.0350		1.4700	
R11 Upstands or kerbs of rooflights				18.0000	0.2400		4.3200	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								12.5070 (36)
Point Thermal bridges								(36a) = 0.0000
Total fabric heat loss								(33) + (36) + (36a) = 189.3669 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	202.5362	201.8481	201.1737	198.0058	197.4131	194.6540	194.6540	194.1431	195.7168	197.4131	198.6122	199.8657	(38)
Average = Sum(39)m / 12 =	391.9032	391.2151	390.5406	387.3728	386.7801	384.0210	384.0210	383.5100	385.0837	386.7801	387.9791	389.2326	(39)
													387.3699
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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HLP	0.9129	0.9113	0.9097	0.9023	0.9010	0.8945	0.8945	0.8933	0.8970	0.9010	0.9037	0.9067 (40)
HLP (average)												0.9023
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.3000 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	34.3325	33.8226	33.1046	31.7807	30.7894	29.6901	29.0964	29.8094	30.5857	31.7619	33.1131	34.2164 (42b)
Hot water usage for other uses	48.4255	46.6646	44.9036	43.1427	41.3818	39.6209	39.6209	41.3818	43.1427	44.9036	46.6646	48.4255 (42c)
Average daily hot water use (litres/day)												75.8548 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	82.7580	80.4872	78.0082	74.9234	72.1712	69.3110	68.7172	71.1912	73.7284	76.6656	79.7777	82.6419 (44)
Energy content (annual)	131.0685	114.6127	119.8958	102.5664	97.1562	85.2260	83.1076	88.1496	90.9145	104.0345	113.6579	129.3973 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
WWHRS	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (64)
12Total per year (kWh/year)												1070.8188 (64)
Electric shower(s)	63.7066	56.7631	61.9832	59.1498	60.2597	57.4819	59.3980	60.2597	59.1498	61.9832	60.8177	63.7066 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												724.6593 (64a)
Heat gains from water heating, kWh/month	43.7787	38.5460	40.9736	36.5828	35.7106	32.4810	32.5099	33.7967	34.1068	37.6031	39.3567	43.4236 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060 (68)
Pumps, fans	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Total internal gains	58.8423	57.3601	55.0721	50.8095	47.9982	45.1125	43.6960	45.4257	47.3705	50.5418	54.6621	58.3650 (72)
	981.3040	1017.0732	968.7620	943.3332	891.6466	861.8239	826.0749	822.0335	848.3151	872.6525	925.6481	956.2881 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				34.6500	10.6334	0.7600	0.7000	0.7700	135.8376 (74)			
South				21.8400	46.7521	0.7600	0.7000	0.7700	376.4422 (78)			
East				3.0000	25.9287	0.7600	0.7000	1.0000	37.2440 (82)			
South				6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)			
Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912 (83)
Total gains	1605.5206	2122.8274	2597.9446	3162.3625	3564.0742	3598.2236	3429.5125	3073.7707	2679.2716	2125.7597	1680.9697	1485.5793 (84)

7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.0841	58.1862	58.2867	58.7634	58.8534	59.2763	59.2763	59.3552	59.1127	58.8534	58.6715	58.4826
alpha	4.8723	4.8791	4.8858	4.9176	4.9236	4.9518	4.9518	4.9570	4.9408	4.9236	4.9114	4.8988
util living area	0.9992	0.9967	0.9879	0.9480	0.8350	0.6465	0.4851	0.5577	0.8282	0.9791	0.9978	0.9995 (86)
MIT	19.3976	19.6429	19.9950	20.4507	20.7980	20.9571	20.9915	20.9838	20.8574	20.3686	19.7923	19.3583 (87)
Th 2	20.1566	20.1579	20.1593	20.1655	20.1667	20.1722	20.1722	20.1732	20.1700	20.1667	20.1643	20.1618 (88)
util rest of house	0.9990	0.9958	0.9845	0.9336	0.7942	0.5754	0.3974	0.4648	0.7703	0.9711	0.9970	0.9993 (89)
MIT 2	18.6613	18.9071	19.2580	19.7066	20.0222	20.1496	20.1693	20.1671	20.0810	19.6346	19.0616	18.6260 (90)
Living area fraction	f _{LA} = Living area / (4) =											0.2182 (91)
MIT	18.8219	19.0676	19.4188	19.8690	20.1915	20.3258	20.3487	20.3453	20.2504	19.7948	19.2210	18.7858 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8219	19.0676	19.4188	19.8690	20.1915	20.3258	20.3487	20.3453	20.2504	19.7948	19.2210	18.7858 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9985	0.9943	0.9807	0.9275	0.7955	0.5892	0.4164	0.4847	0.7766	0.9665	0.9959	0.9990 (94)
Useful gains	1603.0985	2110.6614	2547.7223	2933.2313	2835.2167	2120.0010	1428.1599	1489.8459	2080.7461	2054.5145	1674.0499	1484.0377 (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	5691.1960	5542.5981	5045.3136	4249.0734	3284.3332	2198.8289	1439.5763	1513.0789	2368.4256	3556.3687	4702.6989	5677.2739 (97)
Space heating kWh	3041.5446	2306.2615	1858.2079	947.4063	334.1427	0.0000	0.0000	0.0000	0.0000	1117.3795	2180.6273	3119.7677 (98a)
Space heating requirement - total per year (kWh/year)												14905.3375
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	3041.5446	2306.2615	1858.2079	947.4063	334.1427	0.0000	0.0000	0.0000	0.0000	1117.3795	2180.6273	3119.7677 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14905.3375
Space heating per m ²												(98c) / (4) = 34.7201 (99)

8c. Space cooling requirement

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

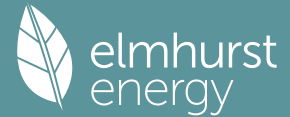
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3609.7972	2841.7553	2914.6763	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8636	0.9226	0.8834	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3117.2414	2621.8729	2574.7502	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3911.7216	3727.8915	3340.1191	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	572.0258	822.8778	569.4345	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	f _C = 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	143.0064	205.7194	142.3586	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												491.0845 (107)
Energy for space heating												34.7201 (99)
Energy for space cooling												1.1439 (108)
Total												35.8640 (109)
Fabric Energy Efficiency (DFEE)												35.9 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (5)

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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)
											Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											40.0000 / (5) =	0.0357 (8)
Pressure test											Yes	
Pressure Test Method											Blower Door	
Measured/design AP50											5.0000 (17)	
Infiltration rate											0.2857 (18)	
Number of sides sheltered											2 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.2429 (21)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3096	0.3036	0.2975	0.2671	0.2611	0.2307	0.2307	0.2246	0.2429	0.2611	0.2732	0.2854 (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	0.5479	0.5461	0.5443	0.5357	0.5341	0.5266	0.5266	0.5252	0.5295	0.5341	0.5373	0.5407 (25)

3. Heat losses and heat loss parameter

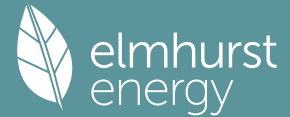
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	2.0221	12.1324		(27a)
Opening			3.0000	1.8519	5.5556		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496		(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408		(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942		(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782		(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1100	3.0613		(30)
External Roof 2	61.9100		61.9100	0.1100	6.8101		(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450		(30)
Total net area of external elements Aum(A, m2)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 181.5503		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							190.8874 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				33.3000	0.0500	1.6650	
E3 Sill				33.3000	0.0500	1.6650	
E4 Jamb				55.4000	0.0500	2.7700	
E5 Ground floor (normal)				59.7000	0.1600	9.5520	
E6 Intermediate floor within a dwelling				49.7900	0.0000	0.0000	
E16 Corner (normal)				42.0000	0.0900	3.7800	
R11 Upstands or kerbs of rooflights				18.0000	0.0800	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.8720 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 202.4223 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	202.5362	201.8481	201.1737	198.0058	197.4131	194.6540	194.6540	194.1431	195.7168	197.4131	198.6122	199.8657 (38)
Average = Sum(39)m / 12 =	404.9585	404.2705	403.5960	400.4281	399.8354	397.0763	397.0763	396.5654	398.1391	399.8354	401.0345	402.2880 (39)
												400.4253
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9433	0.9417	0.9401	0.9327	0.9314	0.9249	0.9249	0.9237	0.9274	0.9314	0.9342	0.9371 (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												3.3000 (42)
Hot water usage for mixer showers												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths												
	34.3325	33.8226	33.1046	31.7807	30.7894	29.6901	29.0964	29.8094	30.5857	31.7619	33.1131	34.2164 (42b)
Hot water usage for other uses												

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Average daily hot water use (litres/day)	48.4255	46.6646	44.9036	43.1427	41.3818	39.6209	39.6209	41.3818	43.1427	44.9036	46.6646	48.4255 (42c) 75.8548 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	82.7580	80.4872	78.0082	74.9234	72.1712	69.3110	68.7172	71.1912	73.7284	76.6656	79.7777	82.6419 (44)
Energy content (annual)	131.0685	114.6127	119.8958	102.5664	97.1562	85.2260	83.1076	88.1496	90.9145	104.0345	113.6579	129.3973 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											1070.8188 (64)
Electric shower(s)	63.7066	56.7631	61.9832	59.1498	60.2597	57.4819	59.3980	60.2597	59.1498	61.9832	60.8177	63.7066 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												724.6593 (64a)
Heat gains from water heating, kWh/month	43.7787	38.5460	40.9736	36.5828	35.7106	32.4810	32.5099	33.7967	34.1068	37.6031	39.3567	43.4236 (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	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001 (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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Water heating gains (Table 5)	58.8423	57.3601	55.0721	50.8095	47.9982	45.1125	43.6960	45.4257	47.3705	50.5418	54.6621	58.3650 (72)
Total internal gains	981.3040	1017.0732	968.7620	943.3332	891.6466	861.8239	826.0749	822.0335	848.3151	872.6525	925.6481	956.2881 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				34.6500	10.6334		0.6300		0.7000		0.7700		112.6022 (74)
South				21.8400	46.7521		0.6300		0.7000		0.7700		312.0508 (78)
East				3.0000	25.9287		0.6300		0.7000		1.0000		30.8733 (82)
South				6.0000	26.0000		0.6300		0.7000		1.0000		61.9164 (82)
Solar gains	517.4427	916.6120	1350.5066	1839.4584	2215.3018	2268.3314	2158.1127	1866.5716	1517.7665	1038.7599	626.1219	438.7545	(83)
Total gains	1498.7467	1933.6852	2319.2686	2782.7917	3106.9484	3130.1553	2984.1876	2688.6051	2366.0817	1911.4124	1551.7700	1395.0427	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.2115	56.3072	56.4013	56.8475	56.9317	57.3273	57.3273	57.4012	57.1743	56.9317	56.7615	56.5847
alpha	4.7474	4.7538	4.7601	4.7898	4.7954	4.8218	4.8218	4.8267	4.8116	4.7954	4.7841	4.7723
util living area	0.9994	0.9978	0.9926	0.9689	0.8926	0.7323	0.5662	0.6410	0.8834	0.9869	0.9984	0.9996 (86)
MIT	19.3046	19.5248	19.8560	20.3062	20.6948	20.9195	20.9815	20.9674	20.7877	20.2663	19.7011	19.2702 (87)
Th 2	20.1309	20.1322	20.1335	20.1398	20.1409	20.1464	20.1464	20.1474	20.1443	20.1409	20.1386	20.1361 (88)
util rest of house	0.9992	0.9972	0.9905	0.9593	0.8598	0.6596	0.4651	0.5381	0.8349	0.9815	0.9979	0.9995 (89)
MIT 2	18.5487	18.7697	19.1006	19.5486	19.9137	20.1019	20.1398	20.1347	20.0049	19.5149	18.9509	18.5183 (90)
Living area fraction	f _{LA} = Living area / (4) =											0.2182 (91)
MIT	18.7136	18.9345	19.2654	19.7140	20.0842	20.2803	20.3235	20.3164	20.1757	19.6788	19.1146	18.6824 (92)
Temperature adjustment												0.0000

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adjusted MIT 18.7136 18.9345 19.2654 19.7140 20.0842 20.2803 20.3235 20.3164 20.1757 19.6788 19.1146 18.6824 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9960	0.9876	0.9534	0.8573	0.6719	0.4868	0.5597	0.8370	0.9776	0.9970	0.9992	(94)
Useful gains	1496.9933	1926.0299	2290.4289	2653.1528	2663.6402	2103.0876	1452.8417	1504.7265	1980.3027	1868.6067	1547.1081	1393.8859	(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	5836.9275	5673.7159	5152.0773	4330.2141	3352.2826	2255.4996	1478.5106	1553.1034	2418.9849	3630.0429	4818.2530	5826.0815	(97)
Space heating kWh	3228.9111	2518.4450	2129.0664	1207.4842	512.3500	0.0000	0.0000	0.0000	0.0000	1310.5086	2355.2243	3297.5535	(98a)
Space heating requirement - total per year (kWh/year)												16559.5430	
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	3228.9111	2518.4450	2129.0664	1207.4842	512.3500	0.0000	0.0000	0.0000	0.0000	1310.5086	2355.2243	3297.5535	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16559.5430	
Space heating per m2											(98c) / (4) =	38.5734	(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	3732.5176	2938.3650	3013.8970	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7859	0.8649	0.8133	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2933.3204	2541.4610	2451.3158	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3388.4394	3229.9010	2908.7053	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	327.6856	512.1993	340.2978	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	81.9214	128.0498	85.0744	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												295.0457	(107)
Energy for space heating												38.5734	(99)
Energy for space cooling												0.6873	(108)
Total												39.2606	(109)
Fabric Energy Efficiency (TFEE)												39.3	(109)

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

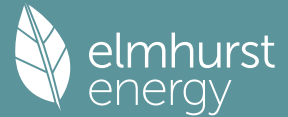
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b)	-
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c)	-
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008	(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	8 * 10 =	80.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		

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Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 80.0000 / (5) = 0.0714 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.3214 (18)
 Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
Effective ac	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210	(22b)
	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998	
E3 Sill	33.3000	0.0190	0.6327	
E4 Jamb	55.4000	0.0060	0.3324	
E5 Ground floor (normal)	59.7000	0.0930	5.5521	
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000	
E16 Corner (normal)	42.0000	0.0350	1.4700	
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5070 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 189.3669 (37)

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

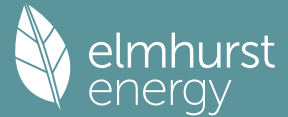
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	207.2426	206.3718	205.5182	201.5089	200.7588	197.2669	197.2669	196.6202	198.6119	200.7588	202.2763	203.8627	(38)
Heat transfer coeff	396.6095	395.7387	394.8851	390.8759	390.1258	386.6338	386.6338	385.9872	387.9789	390.1258	391.6432	393.2297	(39)
Average = Sum(39)m / 12 =													390.8723

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9239	0.9218	0.9198	0.9105	0.9087	0.9006	0.9006	0.8991	0.9037	0.9087	0.9123	0.9160	(40)
HLP (average)													0.9105
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.3000 (42)
Hot water usage for mixer showers	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456 (42a)
Hot water usage for baths	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173 (42b)
Hot water usage for other uses	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742 (42c)
Average daily hot water use (litres/day)												153.1900 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372 (44)
Energy conte	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872 (45)
Energy content (annual)	Total = Sum(45)m =										2544.4469	
Distribution loss (46)m = 0.15 x (45)m	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431 (46)
Water storage loss:												
Store volume												210.0000 (47)

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a) If manufacturer declared loss factor is known (kWh/day):	1.9000	(48)
Temperature factor from Table 2b	0.7800	(49)
Enter (49) or (54) in (55)	1.4820	(55)
Total storage loss		
45.9420 41.4960 45.9420 44.4600 45.9420 44.4600 45.9420 45.9420 44.4600 45.9420 44.4600 45.9420		(56)
If cylinder contains dedicated solar storage		
45.9420 41.4960 45.9420 44.4600 45.9420 44.4600 45.9420 45.9420 44.4600 45.9420 44.4600 45.9420		(57)
Primary loss 54.8576 49.5488 54.8576 53.0880 54.8576 22.5120 23.2624 23.2624 22.5120 54.8576 53.0880 54.8576		(59)
Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(61)
Total heat required for water heating calculated for each month		
364.7548 323.2661 344.7568 305.8290 298.4067 240.3920 237.1335 246.4970 249.1633 309.4880 326.1644 361.0868		(62)
WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(63a)
PV diverter 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(63b)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(63c)
FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(63d)
Output from w/h		
364.7548 323.2661 344.7568 305.8290 298.4067 240.3920 237.1335 246.4970 249.1633 309.4880 326.1644 361.0868		(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 =		(64a)
Heat gains from water heating, kWh/month		
131.6512 116.8526 125.0019 111.7238 109.5904 75.6718 74.4463 77.5597 78.5882 113.2750 118.4854 130.4316		(65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417
Pumps, fans	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water heating gains (Table 5)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008
Total internal gains	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113
	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108

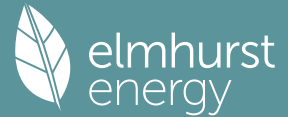
6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North				34.6500	10.6334	0.7600	0.7000		0.7700		135.8376 (74)	
South				21.8400	46.7521	0.7600	0.7000		0.7700		376.4422 (78)	
East				3.0000	25.9287	0.7600	0.7000		1.0000		37.2440 (82)	
South				6.0000	26.0000	0.7600	0.7000		1.0000		74.6928 (82)	
Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912 (83)
Total gains	1842.4697	2319.8156	2801.2109	3316.7169	3691.8807	3653.2833	3481.0807	3134.6940	2754.9752	2281.7263	1866.6139	1711.7020 (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, n1,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881	
util living area	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592	
	0.9985	0.9952	0.9837	0.9397	0.8229	0.6417	0.4812	0.5510	0.8187	0.9729	0.9964	0.9990 (86)	
Living	19.7752	19.9498	20.2148	20.5440	20.7930	20.9054	20.9308	20.9254	20.8342	20.4893	20.0646	19.7461	
Non living	18.6807	18.9053	19.2438	19.6595	19.9480	20.0649	20.0835	20.0821	20.0018	19.5999	19.0592	18.6486	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)	
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (88)	
util rest of house	0.9981	0.9939	0.9794	0.9236	0.7806	0.5705	0.3937	0.4583	0.7593	0.9628	0.9953	0.9987 (89)	
MIT 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (90)	
Living area fraction	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (92)	
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (93)	
Temperature adjustment													
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (93)	

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9804	0.9275	0.7905	0.5866	0.4131	0.4791	0.7736	0.9653	0.9956	0.9987	(94)
Useful gains	1839.1535	2306.4268	2746.4015	3076.1664	2918.5269	2143.1708	1438.0291	1501.8549	2131.1382	2202.6184	1858.3897	1709.5551	(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	6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)
Space heating kWh	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98a)
Space heating requirement - total per year (kWh/year)												16316.4589	
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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16316.4589	
Space heating per m2										(98c) / (4) =		38.0071	(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 %)													332.9430 (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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98)
Space heating efficiency (main heating system 1)	332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)	1010.0081	767.3170	607.1974	301.9571	101.3329	0.0000	0.0000	0.0000	0.0000	357.2070	719.5530	1036.1040	(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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													4900.6765 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													114.8400
Water heating fuel used													3140.8381 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year													0.0000 (231)
Electricity for lighting (calculated in Appendix L)													615.5363 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV generation													0.0000 (233)
Wind generation													0.0000 (234)
Hydro-electric generation (Appendix N)													0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (235)
Appendix Q - special features													
Energy saved or generated													-0.0000 (236)
Energy used													0.0000 (237)
Total delivered energy for all uses													8657.0509 (238)

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10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4900.6765	16.4900	808.1216 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	16.4900	517.9242 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	615.5363	16.4900	101.5019 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1427.5477 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] = 1.0835 (257)$
SAP value	82.4360
SAP rating (Section 12)	82 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4900.6765	0.1557	762.9767 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1207.4398 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Total CO2, kg/year			1296.2807 (272)
CO2 emissions per m2			3.0200 (273)
EI value			96.3377
EI rating			96 (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

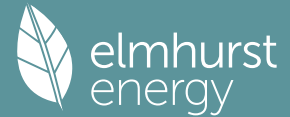
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1120.1008 (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	8 * 10 = 80.0000 (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) =	80.0000 / (5) =	0.0714 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)

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Infiltration rate													0.3214 (18)
Number of sides sheltered													2 (19)
Shelter factor													(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) = 0.2732 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	4.5000	4.3000	4.3000	3.9000	4.0000	3.7000	3.7000	3.4000	3.5000	3.8000	3.7000	4.1000	(22)
Adj infilt rate	1.1250	1.0750	1.0750	0.9750	1.0000	0.9250	0.9250	0.8500	0.8750	0.9500	0.9250	1.0250	(22a)
Effective ac	0.3074	0.2937	0.2937	0.2664	0.2732	0.2527	0.2527	0.2322	0.2391	0.2595	0.2527	0.2800	(22b)
	0.5472	0.5431	0.5431	0.5355	0.5373	0.5319	0.5319	0.5270	0.5286	0.5337	0.5319	0.5392	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)

Heat capacity Cm = Sum(A x k)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
 (28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)
 190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998	(32c)
E3 Sill	33.3000	0.0190	0.6327	(32d)
E4 Jamb	55.4000	0.0060	0.3324	(32d)
E5 Ground floor (normal)	59.7000	0.0930	5.5521	(32d)
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000	(32e)
E16 Corner (normal)	42.0000	0.0350	1.4700	(32e)
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200	(32e)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.5070	(36)
Point Thermal bridges			0.0000	(36a) =
Total fabric heat loss			(33) + (36) + (36a) =	189.3669 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	202.2763	200.7588	200.7588	197.9308	198.6119	196.6202	196.6202	194.7837	195.3786	197.2669	196.6202	199.3103	(38)
Average = Sum(39)m / 12 =	391.6432	390.1258	390.1258	387.2977	387.9789	385.9872	385.9872	384.1507	384.7456	386.6338	385.9872	388.6772	(39)
												387.4450	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9123	0.9087	0.9087	0.9022	0.9037	0.8991	0.8991	0.8948	0.8962	0.9006	0.8991	0.9054	(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													3.3000 (42)
Hot water usage for mixer showers													
	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)
Hot water usage for baths													
	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	(42b)
Hot water usage for other uses													
	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	(42c)
Average daily hot water use (litres/day)													153.1900 (43)
Daily hot water use													
	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372	(44)
Energy conte	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.4820 (55)
Total storage loss													

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	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (56)
If cylinder contains dedicated solar storage	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (64)
	Total per year (kWh/year) = Sum(64)m =											3606.9385 (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												
	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316 (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	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001 (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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113 (72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				34.6500	12.3808	0.7600	0.7000	0.7700	158.1603 (74)			
South				21.8400	52.6843	0.7600	0.7000	0.7700	424.2080 (78)			
East				3.0000	30.6234	0.7600	0.7000	1.0000	43.9874 (82)			
South				6.0000	31.0000	0.7600	0.7000	1.0000	89.0568 (82)			
Solar gains	715.4125	1106.4472	1635.1565	2314.8067	2719.0408	2966.0787	2791.1278	2450.4112	1992.2816	1359.4931	836.7843	581.0604 (83)
Total gains	1933.6656	2320.5086	2807.1848	3412.4944	3738.4940	3882.9623	3668.7710	3333.3681	2916.3003	2388.1122	1948.0766	1763.4712 (84)

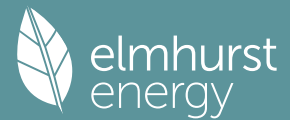
7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, n _{l,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.1226	58.3487	58.3487	58.7748	58.6716	58.9743	58.9743	59.2562	59.1646	58.8757	58.9743	58.5661
alpha	4.8748	4.8899	4.8899	4.9183	4.9114	4.9316	4.9316	4.9504	4.9443	4.9250	4.9316	4.9044
util living area	0.9978	0.9941	0.9786	0.9086	0.7393	0.4798	0.3045	0.3558	0.6962	0.9509	0.9944	0.9985 (86)
Living	19.8814	20.0355	20.3136	20.6542	20.8635	20.9303	20.9367	20.9363	20.8976	20.6139	20.1760	19.8505
Non living	18.8243	19.0237	19.3765	19.7974	20.0241	20.0843	20.0876	20.0913	20.0649	19.7585	19.2103	18.7894
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (88)
util rest of house	0.9972	0.9925	0.9726	0.8845	0.6825	0.4016	0.2175	0.2616	0.6148	0.9323	0.9926	0.9981 (89)
MIT 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (90)
Living area fraction	f _{LA} = Living area / (4) =											
MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9929	0.9740	0.8903	0.6956	0.4189	0.2365	0.2823	0.6336	0.9370	0.9930	0.9982	(94)
Useful gains	1928.4407	2304.0793	2734.2748	3038.0488	2600.3799	1626.7495	867.8339	940.8698	1847.8402	2237.5729	1934.5226	1760.3160	(95)
Ext temp.	5.0000	5.6000	7.4000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.7000	7.9000	5.0000	(96)
Heat loss rate W	6008.2035	5751.7628	5049.5365	4007.6518	2811.5568	1640.3517	868.3774	942.1686	1943.6116	3343.9017	4805.4465	5964.4836	(97)
Space heating kwh	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008	(98a)
Space heating requirement - total per year (kWh/year)												13948.0459	
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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13948.0459	
Space heating per m2										(98c) / (4) =		32.4902	(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 %)													332.9016 (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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008	(98)
Space heating efficiency (main heating system 1)	332.9016	332.9016	332.9016	332.9016	332.9016	0.0000	0.0000	0.0000	0.0000	332.9016	332.9016	332.9016	(210)
Space heating fuel (main heating system)	911.7839	695.9543	517.4365	209.7058	47.1958	0.0000	0.0000	0.0000	0.0000	247.2528	620.9237	939.5871	(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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4189.8400	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												3140.8381	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												615.5363	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												7946.2144	(238)

10a. Fuel costs - using BEDF prices (514)

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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4189.8400	18.3900	770.5116 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	18.3900	577.6001 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	615.5363	18.3900	113.1971 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1461.3088 (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	4189.8400	0.1565	655.8976 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1100.3607 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Total CO2, kg/year			1189.2016 (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	4189.8400	1.5796	6618.0686 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	1.5233	4784.4360 (278)
Space and water heating			11402.5046 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Total Primary energy kWh/year			12346.6348 (286)

SAP 10 EPC IMPROVEMENTS

00001

Current energy efficiency rating: B 82
Current environmental impact rating: A 96

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 102	-70 kg (5.9%)
U Solar photovoltaic panels	+ 2.7	-£ 251	-237 kg (21.2%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£102	0.16 kg/m²	B 83 A 97
Solar photovoltaic panels	£251	0.55 kg/m²	B 86 A 97
Total Savings	£353	0.71 kg/m²	

Potential energy efficiency rating: B 86
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 514 TEST (30 Mar 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£1461	£1359	£102
Space heating	£771	£785	-£15
Water heating	£578	£461	£117
Lighting	£113	£113	£0
Generated (PV)	-£0	-£251	£251
Total cost of fuels	£1461	£1108	£353
Total cost of uses	£1462	£1108	£353
Delivered energy	19 kWh/m²	13 kWh/m²	6 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.9 tonnes	0.3 tonnes
CO2 emissions per m²	3 kg/m²	2 kg/m²	1 kg/m²
Primary energy	29 kWh/m²	22 kWh/m²	7 kWh/m²

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008 (5)

2. Ventilation rate

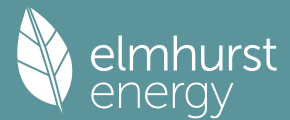
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	8 * 10 = 80.0000 (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) =	Air changes per hour 80.0000 / (5) = 0.0714 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3214 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210 (22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515 (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 = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	1.1450	6.8702		(27a)
Opening			3.0000	1.1450	3.4351		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000 (28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000 (29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000 (29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100 (29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700 (30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900 (30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000 (30)
Total net area of external elements Aum(A, m ²)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	176.8599		(33)
Internal Wall 1			566.3900			9.0000	5097.5100 (32c)
Internal Floor 1			132.1200			18.0000	2378.1600 (32d)
Internal Floor 2			84.2400			18.0000	1516.3200 (32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400 (32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	81947.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							190.8874 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				33.3000	0.0060	0.1998	
E3 Sill				33.3000	0.0190	0.6327	

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E4 Jamb	55.4000	0.0060	0.3324	
E5 Ground floor (normal)	59.7000	0.0930	5.5521	
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000	
E16 Corner (normal)	42.0000	0.0350	1.4700	
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				12.5070 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	189.3669 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)				
(38)m	Jan 207.2426	Feb 206.3718	Mar 205.5182	Apr 201.5089
Heat transfer coeff	May 200.7588	Jun 197.2669	Jul 197.2669	Aug 196.6202
Average = Sum(39)m / 12 =	Sep 198.6119	Oct 200.7588	Nov 202.2763	Dec 203.8627 (38)
HLP	0.9239	0.9218	0.9198	0.9105
HLP (average)	0.9105	0.9087	0.9006	0.9006
Days in mont	31	28	31	30
				31

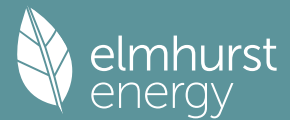
4. Water heating energy requirements (kWh/year)				

Assumed occupancy				3.3000 (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)				
Daily hot water use				
Energy conte				
Energy content (annual)				
Distribution loss (46)m = 0.15 x (45)m				
Water storage loss:				
Store volume				
a) If manufacturer declared loss factor is known (kWh/day):				
Temperature factor from Table 2b				
Enter (49) or (54) in (55)				
Total storage loss				
If cylinder contains dedicated solar storage				
Primary loss				
Combi loss				
Total heat required for water heating calculated for each month				
WWHRS				
PV diverter				
Aperture area of solar collector				
Zero-loss collector efficiency				
Collector linear heat loss coefficient				
Collector 2nd order heat loss coefficient				
Collector loop efficiency				
Incidence angle modifier				
Overshading factor				
Overall heat loss coefficient of system				
Heat loss coefficient of collector loop				
Dedicated solar storage volume				
Effective solar volume				
Reference volume				
Storage tank correction coefficient				
Heat delivered to hot water				
Heat delivered to space heating				
Solar input				
Solar input				
FGHRS				
Output from w/h				
Electric shower(s)				
Heat gains from water heating, kWh/month				

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 198.0012	Feb 198.0012	Mar 198.0012	Apr 198.0012	May 198.0012	Jun 198.0012	Jul 198.0012	Aug 198.0012	Sep 198.0012	Oct 198.0012	Nov 198.0012	Dec 198.0012 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573 (67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)												
176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains												
1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	34.6500	10.6334	0.7600	0.7000	0.7700	135.8376 (74)
South	21.8400	46.7521	0.7600	0.7000	0.7700	376.4422 (78)
East	3.0000	25.9287	0.7600	0.7000	1.0000	37.2440 (82)
South	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)
Solar gains						
624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375
2251.7371	1830.9564	1253.1072	755.3216	529.2912	(83)	
Total gains						
1842.4697	2319.8156	2801.2109	3316.7169	3691.8807	3653.2833	3481.0807
3134.6940	2754.9752	2281.7263	1866.6139	1711.7020	(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	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881
alpha	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592
util living area												
0.9985	0.9952	0.9837	0.9397	0.8229	0.6417	0.4812	0.5510	0.8187	0.9729	0.9964	0.9990	(86)
Living	19.7752	19.9498	20.2148	20.5440	20.7930	20.9054	20.9308	20.9254	20.8342	20.4893	20.0646	19.7461
Non living	18.6807	18.9053	19.2438	19.6595	19.9480	20.0649	20.0835	20.0821	20.0018	19.5999	19.0592	18.6486
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (88)
util rest of house												
0.9981	0.9939	0.9794	0.9236	0.7806	0.5705	0.3937	0.4583	0.7593	0.9628	0.9953	0.9987	(89)
MIT 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (90)
Living area fraction												0.2182 (91)
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9804	0.9275	0.7905	0.5866	0.4131	0.4791	0.7736	0.9653	0.9956	0.9987 (94)
Useful gains	1839.1535	2306.4268	2746.4015	3076.1664	2918.5269	2143.1708	1438.0291	1501.8549	2131.1382	2202.6184	1858.3897	1709.5551 (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												
6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)
Space heating kWh												
3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98a)
Space heating requirement - total per year (kWh/year)												16316.4589
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)												
3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16316.4589
Space heating per m2												(98c) / (4) =
												38.0071 (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 %)												332.9430 (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												

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3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98)
Space heating efficiency (main heating system 1)												
332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)												
1010.0081	767.3170	607.1974	301.9571	101.3329	0.0000	0.0000	0.0000	0.0000	357.2070	719.5530	1036.1040	(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												
364.7548	307.1100	284.4682	220.8456	184.0419	136.7075	133.8421	157.5432	189.3216	280.5036	326.1644	361.0868	(64)
Efficiency of water heater												
(217)m	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month												
317.6200	267.4242	247.7083	192.3072	160.2594	119.0418	116.5466	137.1849	164.8568	244.2560	284.0164	314.4260	(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	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	(232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-42.9284	-66.9775	-105.0531	-125.7614	-138.2302	-125.9658	-124.2011	-114.1779	-96.8680	-79.2449	-49.1803	(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	(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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-7.1581	-16.6025	-37.2931	-65.0107	-97.4525	-105.7479	-104.4504	-85.5960	-59.5951	-27.6009	-10.2295	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											4900.6765	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											114.8400	
Water heating fuel used											2565.6475	(219)
Space cooling fuel											0.0000	(221)
Electricity for pumps and fans:												
pump for solar water heating											80.0000	(230g)
Total electricity for the above, kWh/year											80.0000	(231)
Electricity for lighting (calculated in Appendix L)											615.5363	(232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											-1727.2394	(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											6434.6210	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4900.6765	16.4900	808.1216 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2565.6475	16.4900	423.0753 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	615.5363	16.4900	101.5019 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1104.9949	16.4900	-182.2137
PV Unit electricity exported	-622.2445	5.5900	-34.7835
Total			-216.9971 (252)
Total energy cost			1128.8937 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)		0.8568 (257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	86.1105
SAP rating (Section 12)		86 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4900.6765	0.1557	762.9767 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2565.6475	0.1447	371.1691 (264)
Space and water heating			1134.1458 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1104.9949	0.1336	-147.6629
PV Unit electricity exported	-622.2445	0.1214	-75.5591
Total			-223.2220 (269)
Total CO2, kg/year			1010.8617 (272)
CO2 emissions per m2			2.3500 (273)
EI value			97.1441
EI rating			97 (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	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (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	8 * 10 = 80.0000 (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) =	80.0000 / (5) = 0.0714 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3214 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.7000	3.7000	3.4000	3.5000	3.8000	3.7000	4.1000 (22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.9250	0.9250	0.8500	0.8750	0.9500	0.9250	1.0250 (22a)
Adj infilt rate	0.3074	0.2937	0.2937	0.2664	0.2732	0.2527	0.2527	0.2322	0.2391	0.2595	0.2527	0.2800 (22b)
Effective ac	0.5472	0.5431	0.5431	0.5355	0.5373	0.5319	0.5319	0.5270	0.5286	0.5337	0.5319	0.5392 (25)

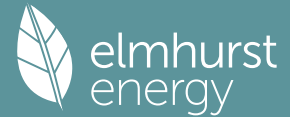
3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
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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
	202.2763	200.7588	200.7588	197.9308	198.6119	196.6202	196.6202	194.7837	195.3786	197.2669	196.6202	199.3103
Heat transfer coeff	391.6432	390.1258	390.1258	387.2977	387.9789	385.9872	385.9872	384.1507	384.7456	386.6338	385.9872	388.6772
Average = Sum(39)m / 12 =												387.4450
HLP												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9123	0.9087	0.9087	0.9022	0.9037	0.8991	0.8991	0.8948	0.8962	0.9006	0.8991	0.9054
HLP (average)												0.9025
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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Heat delivered to hot water												729.7645 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												729.7645
Solar input	-0.0000	-17.5861	-62.3917	-91.5176	-118.2153	-115.3721	-113.6481	-100.9242	-70.1493	-37.5927	-2.3675	-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	364.7548	305.6801	282.3652	214.3113	180.1914	125.0199	123.4854	145.5727	179.0141	271.8953	323.7970	361.0868 (64)
												Total per year (kWh/year) = Sum(64)m = 2877.1740 (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	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316 (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	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				34.6500	12.3808	0.7600	0.7000	0.7700	158.1603 (74)			
South				21.8400	52.6843	0.7600	0.7000	0.7700	424.2080 (78)			
East				3.0000	30.6234	0.7600	0.7000	1.0000	43.9874 (82)			
South				6.0000	31.0000	0.7600	0.7000	1.0000	89.0568 (82)			
Solar gains	715.4125	1106.4472	1635.1565	2314.8067	2719.0408	2966.0787	2791.1278	2450.4112	1992.2816	1359.4931	836.7843	581.0604 (83)
Total gains	1933.6656	2320.5086	2807.1848	3412.4944	3738.4940	3882.9623	3668.7710	3333.3681	2916.3003	2388.1122	1948.0766	1763.4712 (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	58.1226	58.3487	58.3487	58.7748	58.6716	58.9743	58.9743	59.2562	59.1646	58.8757	58.9743	58.5661	
alpha	4.8748	4.8899	4.8899	4.9183	4.9114	4.9316	4.9316	4.9504	4.9443	4.9250	4.9316	4.9044	
util living area	0.9978	0.9941	0.9786	0.9086	0.7393	0.4798	0.3045	0.3558	0.6962	0.9509	0.9944	0.9985	(86)
Living	19.8814	20.0355	20.3136	20.6542	20.8635	20.9303	20.9367	20.9363	20.8976	20.6139	20.1760	19.8505	
Non living	18.8243	19.0237	19.3765	19.7974	20.0241	20.0843	20.0876	20.0913	20.0649	19.7585	19.2103	18.7894	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629	(88)
util rest of house	0.9972	0.9925	0.9726	0.8845	0.6825	0.4016	0.2175	0.2616	0.6148	0.9323	0.9926	0.9981	(89)
MIT 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629	(90)
Living area fraction	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456	(91)
MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9973	0.9929	0.9740	0.8903	0.6956	0.4189	0.2365	0.2823	0.6336	0.9370	0.9930	0.9982	(94)
Ext temp.	1928.4407	2304.0793	2734.2748	3038.0488	2600.3799	1626.7495	867.8339	940.8698	1847.8402	2237.5729	1934.5226	1760.3160	(95)
Heat loss rate W	5.0000	5.0000	7.4000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.7000	7.9000	5.0000	(96)
	6008.2035	5751.7628	5049.5365	4007.6518	2811.5568	1640.3517	868.3774	942.1686	1943.6116	3343.9017	4805.4465	5964.4836	(97)

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Space heating kWh	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98a)
Space heating requirement - total per year (kWh/year)												13948.0459
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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13948.0459
Space heating per m2											(98c) / (4) =	32.4902 (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 %)	332.9016 (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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98)
Space heating efficiency (main heating system 1)	332.9016	332.9016	332.9016	332.9016	332.9016	0.0000	0.0000	0.0000	0.0000	332.9016	332.9016	332.9016 (210)
Space heating fuel (main heating system)	911.7839	695.9543	517.4365	209.7058	47.1958	0.0000	0.0000	0.0000	0.0000	247.2528	620.9237	939.5871 (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	364.7548	305.6801	282.3652	214.3113	180.1914	125.0199	123.4854	145.5727	179.0141	271.8953	323.7970	361.0868 (64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400 (216)
Fuel for water heating, kWh/month	317.6200	266.1791	245.8770	186.6173	156.9064	108.8645	107.5282	126.7613	155.8813	236.7601	281.9549	314.4260 (219)

Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-48.9246	-67.2099	-104.7960	-127.3421	-136.9403	-132.0371	-129.3155	-120.4949	-103.0669	-84.0014	-54.0754	-39.9464 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-9.0937	-17.1785	-38.7749	-71.6149	-102.0835	-118.1186	-114.9108	-96.5315	-67.6567	-32.8099	-12.4224	-6.5715 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year												
Space heating fuel - main system 1												4189.8400 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												114.8400
Water heating fuel used												2505.3762 (219)
Space cooling fuel												0.0000 (221)

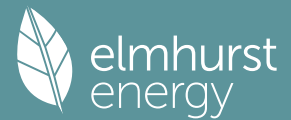
Electricity for pumps and fans:												
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												80.0000 (231)
Electricity for lighting (calculated in Appendix L)												615.5363 (232)

Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1835.9177 (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												5554.8347 (238)

10a. Fuel costs - using BEDF prices (514)

	Fuel price kWh/year	Fuel cost p/kWh	Fuel cost £/year
Space heating - main system 1	4189.8400	18.3900	770.5116 (240)
Total CO2 associated with community systems			0.0000 (473)

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Water heating (other fuel)	2505.3762	18.3900	460.7387 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	18.3900	14.7120 (249)
Energy for lighting	615.5363	18.3900	113.1971 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1148.1507	18.3900	-211.1449
PV Unit electricity exported	-687.7670	5.8100	-39.9593
Total			-251.1042 (252)
Total energy cost			1108.0552 (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	4189.8400	0.1565	655.8976 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2505.3762	0.1451	363.6180 (264)
Space and water heating			1019.5156 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1148.1507	0.1336	-153.4170
PV Unit electricity exported	-687.7670	0.1212	-83.3915
Total			-236.8086 (269)
Total CO2, kg/year			882.6449 (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	4189.8400	1.5796	6618.0686 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2505.3762	1.5369	3850.4165 (278)
Space and water heating			10468.4851 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1148.1507	1.4938	-1715.0917
PV Unit electricity exported	-687.7670	0.4447	-305.8801
Total			-2020.9718 (283)
Total Primary energy kWh/year			9512.6675 (286)

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Property Reference	UB10 8AA				Issued on Date	31/03/2023	
Assessment Reference	00001			Prop Type Ref			
Property	25, Warren Road, Ickenham, UB10 8AA						
SAP Rating	86 B		DER	2.49		TER	7.02
Environmental	97 A		% DER < TER				64.53
CO ₂ Emissions (t/year)	0.93		DFEE	35.86		TFEE	39.26
Compliance Check	See BREL		% DFEE < TFEE				8.65
% DPER < TPER	30.97		DPER	26.05		TPER	37.74
Assessor Details	Mr. Neil Vanson					Assessor ID	M057-0001
Client							

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	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b)	-
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c)	-
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008	(5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	8 * 10 = 80.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

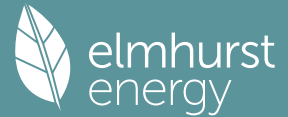
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.0714 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3214	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2732	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210	(22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)

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External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100 (29a)						
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700 (30)						
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900 (30)						
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000 (30)						
Total net area of external elements Aum(A, m2)			738.3900				(31)						
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	176.8599			(33)						
Internal Wall 1			566.3900			9.0000	5097.5100 (32c)						
Internal Floor 1			132.1200			18.0000	2378.1600 (32d)						
Internal Floor 2			84.2400			18.0000	1516.3200 (32d)						
Internal Ceiling 1			193.4600			9.0000	1741.1400 (32e)						
Internal Ceiling 2			132.1200			9.0000	1189.0800 (32e)						
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	81947.9800 (34)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							190.8874 (35)						
List of Thermal Bridges													
K1 Element					Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)					33.3000	0.0060	0.1998						
E3 Sill					33.3000	0.0190	0.6327						
E4 Jamb					55.4000	0.0060	0.3324						
E5 Ground floor (normal)					59.7000	0.0930	5.5521						
E6 Intermediate floor within a dwelling					49.7900	0.0000	0.0000						
E16 Corner (normal)					42.0000	0.0350	1.4700						
R11 Upstands or kerbs of rooflights					18.0000	0.2400	4.3200						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.5070 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	189.3669 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	207.2426	206.3718	205.5182	201.5089	200.7588	197.2669	197.2669	196.6202	198.6119	200.7588	202.2763	203.8627	
Average = Sum(39)m / 12 =	396.6095	395.7387	394.8851	390.8759	390.1258	386.6338	386.6338	385.9872	387.9789	390.1258	391.6432	393.2297	(39)
													390.8723
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	0.9239	0.9218	0.9198	0.9105	0.9087	0.9006	0.9006	0.8991	0.9037	0.9087	0.9123	0.9160	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
													0.9105

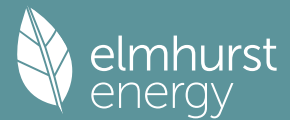
4. Water heating energy requirements (kWh/year)													

Assumed occupancy													3.3000 (42)
Hot water usage for mixer showers													
	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)
Hot water usage for baths													
	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	(42b)
Hot water usage for other uses													
	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	(42c)
Average daily hot water use (litres/day)													153.1900 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372	(44)
Energy conte	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.4820 (55)
Total storage loss													
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(56)
If cylinder contains dedicated solar storage													
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(62)
WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
12Total per year (kWh/year)													3606.9385 (64)
Electric shower(s)													3607 (64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month													
	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316	(65)

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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(66)m	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains	1099.4122	1133.6009	1081.7031	1047.6958	990.9474	921.8110	882.4412	880.8548	910.0949	974.3620	1035.5490	1073.2344	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				34.6500	10.6334		0.7600		0.7000		0.7700		135.8376 (74)
South				21.8400	46.7521		0.7600		0.7000		0.7700		376.4422 (78)
East				3.0000	25.9287		0.7600		0.7000		1.0000		37.2440 (82)
South				6.0000	26.0000		0.7600		0.7000		1.0000		74.6928 (82)
Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912	(83)
Total gains	1723.6288	2239.3551	2710.8857	3266.7250	3663.3750	3658.2108	3485.8787	3132.5919	2741.0513	2227.4692	1790.8706	1602.5255	(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	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881		
alpha	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592		
util living area	0.9989	0.9959	0.9857	0.9427	0.8262	0.6410	0.4806	0.5513	0.8209	0.9752	0.9970	0.9992	(86)	
Living	19.7466	19.9307	20.1945	20.5350	20.7902	20.9055	20.9308	20.9254	20.8329	20.4777	20.0465	19.7197		
Non living	18.6441	18.8810	19.2183	19.6488	19.9452	20.0650	20.0836	20.0821	20.0006	19.5858	19.0360	18.6147		
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0		
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31		
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0		
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)	
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539	(88)	
util rest of house	0.9986	0.9948	0.9819	0.9272	0.7842	0.5698	0.3931	0.4586	0.7618	0.9660	0.9961	0.9990	(89)	
MIT 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539	(90)	
Living area fraction									flA = Living area / (4) =			0.2182	(91)	
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386	(92)	
Temperature adjustment												0.0000		
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	1721.3215	2228.2344	2664.2611	3041.2286	2908.9817	2143.5665	1438.0954	1501.7929	2126.9480	2156.8506	1784.2793	1601.0322	(94)	
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	(95)	
Heat loss rate W	6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)	
Space heating kWh	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98a)	
Space heating requirement - total per year (kWh/year)												16718.1923		
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	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												16718.1923		
Space heating per m2										(98c) / (4) =		38.9429	(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 %)	332.9430	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3450.4180	2607.2735	2082.7337	1030.5001	344.4825	0.0000	0.0000	0.0000	0.0000	1223.3469	2449.0609	3530.3767	(98)
Space heating efficiency (main heating system 1)	332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)	1036.3390	783.0991	625.5526	309.5125	103.4659	0.0000	0.0000	0.0000	0.0000	367.4344	735.5796	1060.3547	(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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260	(217)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-52.6061	-85.3580	-139.8523	-176.2742	-203.4600	-190.5369	-187.9562	-169.3654	-138.9539	-105.1031	-61.5238	-44.2403	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.0884	-5.9113	-15.5898	-32.0489	-53.9056	-62.4945	-61.7313	-48.7878	-31.9038	-11.5726	-3.3517	-1.5296	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												5021.3378	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												3140.8381	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												615.5363	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1886.1454	(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												6891.5668	(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	5021.3378	0.1557	781.7279 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1226.1910 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1555.2301	0.1325	-206.1375
PV Unit electricity exported	-330.9153	0.1177	-38.9332
Total			-245.0707 (269)
Total CO2, kg/year			1069.9612 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.4900 (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	5021.3378	1.5764	7915.4296 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	1.5233	4784.4360 (278)

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Space and water heating			12699.8657 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1555.2301	1.4898	-2316.9131
PV Unit electricity exported	-330.9153	0.4313	-142.7259
Total			-2459.6391 (283)
Total Primary energy kWh/year			11184.3568 (286)
Dwelling Primary energy Rate (DPER)			26.0500 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (5)

2. Ventilation rate

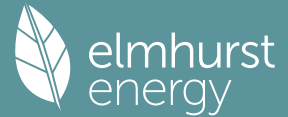
		m ³ per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) =	0.0357 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.2857	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2429 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3096	0.3036	0.2975	0.2671	0.2611	0.2307	0.2307	0.2246	0.2429	0.2611	0.2732	0.2854 (22b)
Effective ac	0.5479	0.5461	0.5443	0.5357	0.5341	0.5266	0.5266	0.5252	0.5295	0.5341	0.5373	0.5407 (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
TER Opening Type (Uw = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	2.0221	12.1324		(27a)
Opening			3.0000	1.8519	5.5556		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496		(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408		(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942		(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782		(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1100	3.0613		(30)
External Roof 2	61.9100		61.9100	0.1100	6.8101		(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450		(30)
Total net area of external elements Aum(A, m ²)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	181.5503		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							190.8874 (35)

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List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	33.3000	0.0500	1.6650
E2 Other lintels (including other steel lintels)	33.3000	0.0500	1.6650
E3 Sill	55.4000	0.0500	2.7700
E4 Jamb	59.7000	0.1600	9.5520
E5 Ground floor (normal)	49.7900	0.0000	0.0000
E6 Intermediate floor within a dwelling	42.0000	0.0900	3.7800
E16 Corner (normal)	18.0000	0.0800	1.4400
R11 Upstands or kerbs of rooflights			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			20.8720 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	202.4223 (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	202.5362	201.8481	201.1737	198.0058	197.4131	194.6540	194.6540	194.1431	195.7168	197.4131	198.6122	199.8657	(38)
Heat transfer coeff	404.9585	404.2705	403.5960	400.4281	399.8354	397.0763	397.0763	396.5654	398.1391	399.8354	401.0345	402.2880	(39)
Average = Sum(39)m / 12 =												400.4253	
HLP	0.9433	0.9417	0.9401	0.9327	0.9314	0.9249	0.9249	0.9237	0.9274	0.9314	0.9342	0.9371	(40)
HLP (average)												0.9327	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3000 (42)
Hot water usage for mixer showers	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)
Hot water usage for baths	34.3325	33.8226	33.1046	31.7807	30.7894	29.6901	29.0964	29.8094	30.5857	31.7619	33.1131	34.2164	(42b)
Hot water usage for other uses	48.4255	46.6646	44.9036	43.1427	41.3818	39.6209	39.6209	41.3818	43.1427	44.9036	46.6646	48.4255	(42c)
Average daily hot water use (litres/day)												149.1977	(43)
Daily hot water use	162.3084	158.8421	154.6211	148.2032	142.9912	137.3879	135.2350	139.4378	143.8702	149.7526	156.2694	161.8876	(44)
Energy conte	257.0569	226.1891	237.6469	202.8827	192.4936	168.9345	163.5550	172.6531	177.4064	203.2129	222.6344	253.4768	(45)
Energy content (annual)										Total = Sum(45)m =		2478.1423	
Distribution loss (46)m = 0.15 x (45)m	38.5585	33.9284	35.6470	30.4324	28.8740	25.3402	24.5332	25.8980	26.6110	30.4819	33.3952	38.0215	(46)
Water storage loss:												210.0000	(47)
Store volume												1.7016	(48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400	(49)
Temperature factor from Table 2b												0.9188	(55)
Enter (49) or (54) in (55)													
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	308.8035	272.9280	289.3935	252.9601	244.2402	219.0118	215.3016	224.3997	227.4837	254.9595	272.7118	305.2234	(62)
WWHRS	-36.3671	-32.1634	-33.6797	-27.8881	-25.9907	-22.2404	-20.8468	-22.1685	-23.0108	-27.1272	-30.7318	-35.6937	(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	272.4364	240.7646	255.7139	225.0720	218.2495	196.7714	194.4547	202.2312	204.4729	227.8323	241.9800	269.5298	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2749.5085	(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	126.8687	112.5990	120.4149	107.5204	105.4014	96.2326	95.7793	98.8044	99.0495	108.9656	114.0878	125.6783	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	170.5224	167.5580	161.8479	149.3339	141.6685	133.6564	128.7356	132.8017	137.5687	146.4591	158.4553	168.9225	(72)
Total internal gains	1095.9841	1130.2710	1078.5378	1044.8577	988.3170	950.3677	911.1145	909.4095	938.5133	971.5697	1032.4413	1069.8456	(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
North				34.6500	10.6334		0.6300		0.7000		0.7700		112.6022 (74)
South				21.8400	46.7521		0.6300		0.7000		0.7700		312.0508 (78)
East				3.0000	25.9287		0.6300		0.7000		1.0000		30.8733 (82)
South				6.0000	26.0000		0.6300		0.7000		1.0000		61.9164 (82)
Solar gains	517.4427	916.6120	1350.5066	1839.4584	2215.3018	2268.3314	2158.1127	1866.5716	1517.7665	1038.7599	626.1219		438.7545 (83)
Total gains	1613.4268	2046.8831	2429.0445	2884.3161	3203.6188	3218.6991	3069.2272	2775.9811	2456.2799	2010.3297	1658.5632		1508.6001 (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	56.2115	56.3072	56.4013	56.8475	56.9317	57.3273	57.3273	57.4012	57.1743	56.9317	56.7615	56.5847
alpha	4.7474	4.7538	4.7601	4.7898	4.7954	4.8218	4.8218	4.8267	4.8116	4.7954	4.7841	4.7723
util living area	0.9992	0.9972	0.9910	0.9645	0.8829	0.7184	0.5524	0.6246	0.8708	0.9839	0.9979	0.9994 (86)
MIT	19.3414	19.5608	19.8899	20.3339	20.7126	20.9259	20.9833	20.9708	20.8034	20.2959	19.7352	19.3067 (87)
Th 2	20.1309	20.1322	20.1335	20.1398	20.1409	20.1464	20.1464	20.1474	20.1443	20.1409	20.1386	20.1361 (88)
util rest of house	0.9989	0.9964	0.9885	0.9539	0.8483	0.6453	0.4529	0.5228	0.8193	0.9775	0.9972	0.9992 (89)
MIT 2	18.1478	18.4298	18.8511	19.4151	19.8685	20.0943	20.1389	20.1329	19.9809	19.3745	18.6582	18.1070 (90)
Living area fraction	18.4083	18.6766	19.0778	19.6156	20.0527	20.2758	20.3231	20.3158	20.1604	19.5756	18.8932	18.3688 (92)
MIT	18.4083	18.6766	19.0778	19.6156	20.0527	20.2758	20.3231	20.3158	20.1604	19.5756	18.8932	18.3688 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4083	18.6766	19.0778	19.6156	20.0527	20.2758	20.3231	20.3158	20.1604	19.5756	18.8932	18.3688 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9982	0.9946	0.9842	0.9456	0.8442	0.6571	0.4742	0.5439	0.8205	0.9717	0.9957	0.9987 (94)
Useful gains	1610.5629	2035.7420	2390.5693	2727.5294	2704.4879	2115.1480	1455.4172	1509.9618	2015.2944	1953.4411	1651.3844	1506.6492 (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	5713.2594	5569.4830	5076.3330	4290.8179	3339.7014	2253.7264	1478.3739	1552.8606	2412.8657	3588.7489	4729.4715	5699.9279 (97)
Space heating kWh	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (98a)
Space heating requirement - total per year (kWh/year)												15576.1459
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	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15576.1459
Space heating per m2										(98c) / (4) =		36.2827 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	3052.4062	2374.6739	1998.2082	1125.5678	472.5989	0.0000	0.0000	0.0000	0.0000	1216.6690	2216.2227	3119.7993 (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)	3307.0489	2572.7778	2164.9059	1219.4667	512.0248	0.0000	0.0000	0.0000	0.0000	1318.1680	2401.1080	3380.0643 (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	272.4364	240.7646	255.7139	225.0720	218.2495	196.7714	194.4547	202.2312	204.4729	227.8323	241.9800	269.5298 (64)
Efficiency of water heater												79.8000 (216)

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(217)m	87.9869	87.8875	87.6781	87.1619	85.7449	79.8000	79.8000	79.8000	79.8000	87.2480	87.8250	88.0107	(217)
Fuel for water heating, kWh/month	309.6329	273.9462	291.6507	258.2230	254.5333	246.5807	243.6776	253.4225	256.2317	261.1318	275.5253	306.2467	(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	61.0493	48.9760	44.0975	32.3077	24.9554	20.3888	22.7652	29.5910	38.4358	50.4299	56.9604	62.7461	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-153.0179	-199.7273	-265.7745	-275.5410	-278.3352	-252.7080	-248.8595	-243.2998	-232.0257	-215.7896	-162.0698	-134.1792	(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	-142.6327	-291.1493	-563.3879	-825.3329	-1072.3773	-1071.3485	-1059.3576	-905.9846	-675.9247	-409.8952	-188.1315	-113.5524	(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												16875.5644	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3230.8025	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												492.7031	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-9980.4019	(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												10704.6681	(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	16875.5644	0.2100	3543.8685 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3230.8025	0.2100	678.4685 (264)
Space and water heating			4222.3370 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	492.7031	0.1443	71.1123 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2661.3275	0.1364	-362.9006
PV Unit electricity exported	-7319.0744	0.1266	-926.8416
Total			-1289.7422 (269)
Total CO2, kg/year			3015.6364 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.0200 (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	16875.5644	1.1300	19069.3878 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3230.8025	1.1300	3650.8068 (278)
Space and water heating			22720.1946 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	492.7031	1.5338	755.7245 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2661.3275	1.5041	-4002.8045
PV Unit electricity exported	-7319.0744	0.4649	-3402.3744
Total			-7405.1789 (283)
Total Primary energy kWh/year			16200.8409 (286)
Target Primary Energy Rate (TPER)			37.7400 (287)

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CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 40.0000 / (5) = 0.0357 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2857 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2429 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3096	0.3036	0.2975	0.2671	0.2611	0.2307	0.2307	0.2246	0.2429	0.2611	0.2732	0.2854 (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	0.5479	0.5461	0.5443	0.5357	0.5341	0.5266	0.5266	0.5252	0.5295	0.5341	0.5373	0.5407 (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 = 1.20)			56.4900	1.1450	64.6832		(27)
Opening			6.0000	1.1450	6.8702		(27a)
Opening			3.0000	1.1450	3.4351		(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000 (28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000 (29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000 (29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100 (29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700 (30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900 (30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000 (30)
Total net area of external elements Aum(A, m ²)			738.3900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	176.8599		(33)
Internal Wall 1			566.3900			9.0000	5097.5100 (32c)
Internal Floor 1			132.1200			18.0000	2378.1600 (32d)
Internal Floor 2			84.2400			18.0000	1516.3200 (32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400 (32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800 (32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	81947.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K		190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998
E3 Sill	33.3000	0.0190	0.6327
E4 Jamb	55.4000	0.0060	0.3324
E5 Ground floor (normal)	59.7000	0.0930	5.5521
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000
E16 Corner (normal)	42.0000	0.0350	1.4700
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.5070 (36)
Point Thermal bridges			(36a) = 0.0000

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Total fabric heat loss (33) + (36) + (36a) = 189.3669 (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	202.5362	201.8481	201.1737	198.0058	197.4131	194.6540	194.6540	194.1431	195.7168	197.4131	198.6122	199.8657	(38)
Heat transfer coeff	391.9032	391.2151	390.5406	387.3728	386.7801	384.0210	384.0210	383.5100	385.0837	386.7801	387.9791	389.2326	(39)
Average = Sum(39)m / 12 =												387.3699	
HLP	0.9129	0.9113	0.9097	0.9023	0.9010	0.8945	0.8945	0.8933	0.8970	0.9010	0.9037	0.9067	(40)
HLP (average)												0.9023	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3000 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	34.3325	33.8226	33.1046	31.7807	30.7894	29.6901	29.0964	29.8094	30.5857	31.7619	33.1131	34.2164	(42b)
Hot water usage for other uses	48.4255	46.6646	44.9036	43.1427	41.3818	39.6209	39.6209	41.3818	43.1427	44.9036	46.6646	48.4255	(42c)
Average daily hot water use (litres/day)												75.8548	(43)
Daily hot water use	82.7580	80.4872	78.0082	74.9234	72.1712	69.3110	68.7172	71.1912	73.7284	76.6656	79.7777	82.6419	(44)
Energy conte	131.0685	114.6127	119.8958	102.5664	97.1562	85.2260	83.1076	88.1496	90.9145	104.0345	113.6579	129.3973	(45)
Energy content (annual)										Total = Sum(45)m =		1259.7869	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		1070.8188	(64)
Electric shower(s)	63.7066	56.7631	61.9832	59.1498	60.2597	57.4819	59.3980	60.2597	59.1498	61.9832	60.8177	63.7066	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												724.6593	(64a)
Heat gains from water heating, kWh/month	43.7787	38.5460	40.9736	36.5828	35.7106	32.4810	32.5099	33.7967	34.1068	37.6031	39.3567	43.4236	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	58.8423	57.3601	55.0721	50.8095	47.9982	45.1125	43.6960	45.4257	47.3705	50.5418	54.6621	58.3650	(72)
Total internal gains	981.3040	1017.0732	968.7620	943.3332	891.6466	861.8239	826.0749	822.0335	848.3151	872.6525	925.6481	956.2881	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	34.6500	10.6334	0.7600	0.7000	0.7700	135.8376 (74)
South	21.8400	46.7521	0.7600	0.7000	0.7700	376.4422 (78)
East	3.0000	25.9287	0.7600	0.7000	1.0000	37.2440 (82)
South	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928 (82)

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Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912 (83)
Total gains	1605.5206	2122.8274	2597.9446	3162.3625	3564.0742	3598.2236	3429.5125	3073.7707	2679.2716	2125.7597	1680.9697	1485.5793 (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	58.0841	58.1862	58.2867	58.7634	58.8534	59.2763	59.2763	59.3552	59.1127	58.8534	58.6715	58.4826	
alpha	4.8723	4.8791	4.8858	4.9176	4.9236	4.9518	4.9518	4.9570	4.9408	4.9236	4.9114	4.8988	
util living area	0.9992	0.9967	0.9879	0.9480	0.8350	0.6465	0.4851	0.5577	0.8282	0.9791	0.9978	0.9995 (86)	
MIT	19.3976	19.6429	19.9950	20.4507	20.7980	20.9571	20.9915	20.9838	20.8574	20.3686	19.7923	19.3583 (87)	
Th 2	20.1566	20.1579	20.1593	20.1655	20.1667	20.1722	20.1722	20.1732	20.1700	20.1667	20.1643	20.1618 (88)	
util rest of house	0.9990	0.9958	0.9845	0.9336	0.7942	0.5754	0.3974	0.4648	0.7703	0.9711	0.9970	0.9993 (89)	
MIT 2	18.6613	18.9071	19.2580	19.7066	20.0222	20.1496	20.1693	20.1671	20.0810	19.6346	19.0616	18.6260 (90)	
Living area fraction	fLA = Living area / (4) =												0.2182 (91)
MIT	18.8219	19.0676	19.4188	19.8690	20.1915	20.3258	20.3487	20.3453	20.2504	19.7948	19.2210	18.7858 (92)	
Temperature adjustment	0.0000												0.0000
adjusted MIT	18.8219	19.0676	19.4188	19.8690	20.1915	20.3258	20.3487	20.3453	20.2504	19.7948	19.2210	18.7858 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9985	0.9943	0.9807	0.9275	0.7955	0.5892	0.4164	0.4847	0.7766	0.9665	0.9959	0.9990 (94)
Useful gains	1603.0985	2110.6614	2547.7223	2933.2313	2835.2167	2120.0010	1428.1599	1489.8459	2080.7461	2054.5145	1674.0499	1484.0377 (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	5691.1960	5542.5981	5045.3136	4249.0734	3284.3332	2198.8289	1439.5763	1513.0789	2368.4256	3556.3687	4702.6989	5677.2739 (97)
Space heating kWh	3041.5446	2306.2615	1858.2079	947.4063	334.1427	0.0000	0.0000	0.0000	0.0000	1117.3795	2180.6273	3119.7677 (98a)
Space heating requirement - total per year (kWh/year)	14905.3375											
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	3041.5446	2306.2615	1858.2079	947.4063	334.1427	0.0000	0.0000	0.0000	0.0000	1117.3795	2180.6273	3119.7677 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	14905.3375											
Space heating per m2	(98c) / (4) = 34.7201 (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	3609.7972	2841.7553	2914.6763	0.0000	0.0000	0.0000	0.0000 (100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8636	0.9226	0.8834	0.0000	0.0000	0.0000	0.0000 (101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3117.2414	2621.8729	2574.7502	0.0000	0.0000	0.0000	0.0000 (102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3911.7216	3727.8915	3340.1191	0.0000	0.0000	0.0000	0.0000 (103)	
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	572.0258	822.8778	569.4345	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	143.0064	205.7194	142.3586	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling requirement													491.0845 (107)
Energy for space heating													34.7201 (99)
Energy for space cooling													1.1439 (108)
Total													35.8640 (109)
Fabric Energy Efficiency (DFEE)													35.9 (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 Storey height Volume

2. Ventilation rate

Full SAP Calculation Printout



4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.3000 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	34.3325	33.8226	33.1046	31.7807	30.7894	29.6901	29.0964	29.8094	30.5857	31.7619	33.1131	34.2164 (42b)
Hot water usage for other uses	48.4255	46.6646	44.9036	43.1427	41.3818	39.6209	39.6209	41.3818	43.1427	44.9036	46.6646	48.4255 (42c)
Average daily hot water use (litres/day)												75.8548 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	82.7580	80.4872	78.0082	74.9234	72.1712	69.3110	68.7172	71.1912	73.7284	76.6656	79.7777	82.6419 (44)
Energy content (annual)	131.0685	114.6127	119.8958	102.5664	97.1562	85.2260	83.1076	88.1496	90.9145	104.0345	113.6579	129.3973 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m =											1259.7869
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	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	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	111.4082	97.4208	101.9114	87.1814	82.5828	72.4421	70.6414	74.9271	77.2774	88.4293	96.6092	109.9877 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				1070.8188 (64)
Electric shower(s)												1071 (64)
	63.7066	56.7631	61.9832	59.1498	60.2597	57.4819	59.3980	60.2597	59.1498	61.9832	60.8177	63.7066 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											724.6593 (64a)
Heat gains from water heating, kWh/month	43.7787	38.5460	40.9736	36.5828	35.7106	32.4810	32.5099	33.7967	34.1068	37.6031	39.3567	43.4236 (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	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010	165.0010 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	293.8168	325.2972	293.8168	303.6107	293.8168	303.6107	293.8168	293.8168	303.6107	293.8168	303.6107	293.8168 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	556.1445	561.9156	547.3727	516.4128	477.3314	440.6003	416.0618	410.2907	424.8336	455.7935	494.8749	531.6060 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001	39.5001 (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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Water heating gains (Table 5)	58.8423	57.3601	55.0721	50.8095	47.9982	45.1125	43.6960	45.4257	47.3705	50.5418	54.6621	58.3650 (72)
Total internal gains	981.3040	1017.0732	968.7620	943.3332	891.6466	861.8239	826.0749	822.0335	848.3151	872.6525	925.6481	956.2881 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				34.6500	10.6334		0.6300		0.7000		0.7700		112.6022 (74)
South				21.8400	46.7521		0.6300		0.7000		0.7700		312.0508 (78)
East				3.0000	25.9287		0.6300		0.7000		1.0000		30.8733 (82)
South				6.0000	26.0000		0.6300		0.7000		1.0000		61.9164 (82)
Solar gains	517.4427	916.6120	1350.5066	1839.4584	2215.3018	2268.3314	2158.1127	1866.5716	1517.7665	1038.7599	626.1219	438.7545	(83)
Total gains	1498.7467	1933.6852	2319.2686	2782.7917	3106.9484	3130.1553	2984.1876	2688.6051	2366.0817	1911.4124	1551.7700	1395.0427	(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	56.2115	56.3072	56.4013	56.8475	56.9317	57.3273	57.3273	57.4012	57.1743	56.9317	56.7615	56.5847
alpha	4.7474	4.7538	4.7601	4.7898	4.7954	4.8218	4.8218	4.8267	4.8116	4.7954	4.7841	4.7723
util living area												

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	0.9994	0.9978	0.9926	0.9689	0.8926	0.7323	0.5662	0.6410	0.8834	0.9869	0.9984	0.9996 (86)
MIT	19.3046	19.5248	19.8560	20.3062	20.6948	20.9195	20.9815	20.9674	20.7877	20.2663	19.7011	19.2702 (87)
Th 2	20.1309	20.1322	20.1335	20.1398	20.1409	20.1464	20.1464	20.1474	20.1443	20.1409	20.1386	20.1361 (88)
util rest of house	0.9992	0.9972	0.9905	0.9593	0.8598	0.6596	0.4651	0.5381	0.8349	0.9815	0.9979	0.9995 (89)
MIT 2	18.5487	18.7697	19.1006	19.5486	19.9137	20.1019	20.1398	20.1347	20.0049	19.5149	18.9509	18.5183 (90)
Living area fraction									fLA = Living area / (4) =			0.2182 (91)
MIT	18.7136	18.9345	19.2654	19.7140	20.0842	20.2803	20.3235	20.3164	20.1757	19.6788	19.1146	18.6824 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7136	18.9345	19.2654	19.7140	20.0842	20.2803	20.3235	20.3164	20.1757	19.6788	19.1146	18.6824 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9988	0.9960	0.9876	0.9534	0.8573	0.6719	0.4868	0.5597	0.8370	0.9776	0.9970	0.9992 (94)
Useful gains	1496.9933	1926.0299	2290.4289	2653.1528	2663.6402	2103.0876	1452.8417	1504.7265	1980.3027	1868.6067	1547.1081	1393.8859 (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	5836.9275	5673.7159	5152.0773	4330.2141	3352.2826	2255.4996	1478.5106	1553.1034	2418.9849	3630.0429	4818.2530	5826.0815 (97)
Space heating kWh	3228.9111	2518.4450	2129.0664	1207.4842	512.3500	0.0000	0.0000	0.0000	0.0000	1310.5086	2355.2243	3297.5535 (98a)
Space heating requirement - total per year (kWh/year)												16559.5430
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	3228.9111	2518.4450	2129.0664	1207.4842	512.3500	0.0000	0.0000	0.0000	0.0000	1310.5086	2355.2243	3297.5535 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16559.5430
Space heating per m2											(98c) / (4) =	38.5734 (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	3732.5176	2938.3650	3013.8970	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7859	0.8649	0.8133	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2933.3204	2541.4610	2451.3158	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3388.4394	3229.9010	2908.7053	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	327.6856	512.1993	340.2978	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	81.9214	128.0498	85.0744	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												295.0457 (107)
Energy for space heating												38.5734 (99)
Energy for space cooling												0.6873 (108)
Total												39.2606 (109)
Fabric Energy Efficiency (TFEE)												39.3 (109)

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

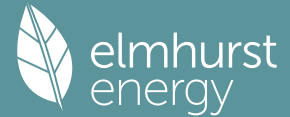
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	201.9200 (1b)	x	2.5400 (2b) = 512.8768 (1b) -
First floor	139.8000 (1c)	x	2.8400 (2c) = 397.0320 (1c) -
Second floor	87.5800 (1d)	x	2.4000 (2d) = 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)

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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	8 * 10 =	80.0000 (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) =	80.0000	Air changes per hour	80.0000 / (5) =	0.0714 (8)
Pressure test			Yes		
Pressure Test Method			Blower Door		
Measured/design AP50			5.0000		(17)
Infiltration rate			0.3214		(18)
Number of sides sheltered			2		(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500			(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2732			(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)
Effective ac	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210	(22b)
	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...	(30) + (32) =	176.8599		(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...	(30) + (32) + (32a)...	(32e) =	81947.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				190.8874	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998	
E3 Sill	33.3000	0.0190	0.6327	
E4 Jamb	55.4000	0.0060	0.3324	
E5 Ground floor (normal)	59.7000	0.0930	5.5521	
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000	
E16 Corner (normal)	42.0000	0.0350	1.4700	
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)				12.5070	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =			189.3669	(37)

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

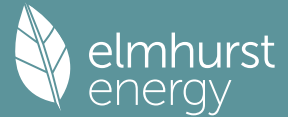
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	207.2426	206.3718	205.5182	201.5089	200.7588	197.2669	197.2669	196.6202	198.6119	200.7588	202.2763	203.8627	(38)
Average = Sum(39)m / 12 =	396.6095	395.7387	394.8851	390.8759	390.1258	386.6338	386.6338	385.9872	387.9789	390.1258	391.6432	393.2297	(39)
													390.8723

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9239	0.9218	0.9198	0.9105	0.9087	0.9006	0.9006	0.8991	0.9037	0.9087	0.9123	0.9160	(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													3.3000	(42)
Hot water usage for mixer showers														
	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)	
Hot water usage for baths														
	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	(42b)	
Hot water usage for other uses														
	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	(42c)	
Average daily hot water use (litres/day)													153.1900	(43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372	(44)
Energy conte	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872	(45)
Energy content (annual)	Total = Sum(45)m = 2544.4469												
Distribution loss (46)m = 0.15 x (45)m	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.4820 (55)
Total storage loss	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(56)
If cylinder contains dedicated solar storage	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Total per year (kWh/year) = Sum(64)m = 3606.9385 (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	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316	(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	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108	(73)

6. Solar gains

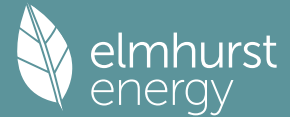
[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	34.6500	10.6334	0.7600	0.7000	0.7700	135.8376	(74)
South	21.8400	46.7521	0.7600	0.7000	0.7700	376.4422	(78)
East	3.0000	25.9287	0.7600	0.7000	1.0000	37.2440	(82)
South	6.0000	26.0000	0.7600	0.7000	1.0000	74.6928	(82)

Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912	(83)
Total gains	1842.4697	2319.8156	2801.2109	3316.7169	3691.8807	3653.2833	3481.0807	3134.6940	2754.9752	2281.7263	1866.6139	1711.7020	(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	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881	
alpha	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592	
util living area	0.9985	0.9952	0.9837	0.9397	0.8229	0.6417	0.4812	0.5510	0.8187	0.9729	0.9964	0.9990	(86)
Living	19.7752	19.9498	20.2148	20.5440	20.7930	20.9054	20.9308	20.9254	20.8342	20.4893	20.0646	19.7461	
Non living	18.6807	18.9053	19.2438	19.6595	19.9480	20.0649	20.0835	20.0821	20.0018	19.5999	19.0592	18.6486	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539	(88)

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util rest of house												
MIT 2	0.9981	0.9939	0.9794	0.9236	0.7806	0.5705	0.3937	0.4583	0.7593	0.9628	0.9953	0.9987 (89)
Living area fraction	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (90)
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	0.2182 (91)
Temperature adjustment												0.3386 (92)
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9804	0.9275	0.7905	0.5866	0.4131	0.4791	0.7736	0.9653	0.9956	0.9987	(94)
Useful gains	1839.1535	2306.4268	2746.4015	3076.1664	2918.5269	2143.1708	1438.0291	1501.8549	2131.1382	2202.6184	1858.3897	1709.5551	(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	6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)
Space heating kWh	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98a)
Space heating requirement - total per year (kWh/year)												16316.4589	
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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16316.4589	
Space heating per m2											(98c) / (4) =	38.0071	(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 %)	332.9430	(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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98)
Space heating efficiency (main heating system 1)	332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)	1010.0081	767.3170	607.1974	301.9571	101.3329	0.0000	0.0000	0.0000	0.0000	357.2070	719.5530	1036.1040	(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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-52.5857	-85.3170	-139.7210	-176.1293	-203.3766	-190.5369	-187.9562	-169.3654	-138.9539	-105.0320	-61.4990	-44.2265	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.1087	-5.9524	-15.7211	-32.1937	-53.9890	-62.4945	-61.7313	-48.7878	-31.9038	-11.6437	-3.3765	-1.5434	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4900.6765	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												3140.8381	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	615.5363	(232)

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Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	-1886.1454 (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	6770.9055 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4900.6765	16.4900	808.1216 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	16.4900	517.9242 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	615.5363	16.4900	101.5019 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1554.6995	16.4900	-256.3700
PV Unit electricity exported	-331.4459	5.5900	-18.5278
Total			-274.8978 (252)
Total energy cost			1152.6499 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600 (256)
Energy cost factor (ECF)	0.8749 (257)
SAP value	85.8183
SAP rating (Section 12)	86 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4900.6765	0.1557	762.9767 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1207.4398 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1554.6995	0.1325	-206.0602
PV Unit electricity exported	-331.4459	0.1177	-39.0176
Total			-245.0778 (269)
Total CO2, kg/year			1051.2029 (272)
CO2 emissions per m2			2.4500 (273)
EI value			97.0301
EI rating			97 (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	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (5)

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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	8 * 10 =	80.0000 (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) =	80.0000 / (5) =	0.0714 (8)	
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3214 (18)
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2732 (21)	

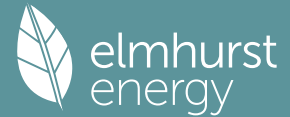
Total storage loss	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (56)
If cylinder contains dedicated solar storage	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (62)
WwHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (64)
								Total per year (kWh/year) = Sum(64)m =				3606.9385 (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	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001 (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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113 (72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108 (73)

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	34.6500	12.3808	0.7600	0.7000	0.7700	158.1603 (74)
South	21.8400	52.6843	0.7600	0.7000	0.7700	424.2080 (78)
East	3.0000	30.6234	0.7600	0.7000	1.0000	43.9874 (82)
South	6.0000	31.0000	0.7600	0.7000	1.0000	89.0568 (82)

Temperature during heating periods in the living area from Table 9, Th1 (C)											21.0000 (85)	
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.1226	58.3487	58.3487	58.7748	58.6716	58.9743	58.9743	59.2562	59.1646	58.8757	58.9743	58.5661
alpha	4.8748	4.8899	4.8899	4.9183	4.9114	4.9316	4.9316	4.9504	4.9443	4.9250	4.9316	4.9044
util living area	0.9978	0.9941	0.9786	0.9086	0.7393	0.4798	0.3045	0.3558	0.6962	0.9509	0.9944	0.9985 (86)
Living	19.8814	20.0355	20.3136	20.6542	20.8635	20.9303	20.9367	20.9363	20.8976	20.6139	20.1760	19.8505

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Non living	18.8243	19.0237	19.3765	19.7974	20.0241	20.0843	20.0876	20.0913	20.0649	19.7585	19.2103	18.7894
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (88)
util rest of house	0.9972	0.9925	0.9726	0.8845	0.6825	0.4016	0.2175	0.2616	0.6148	0.9323	0.9926	0.9981 (89)
MIT 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9973	0.9929	0.9740	0.8903	0.6956	0.4189	0.2365	0.2823	0.6336	0.9370	0.9930	0.9982 (94)
Useful gains	1928.4407	2304.0793	2734.2748	3038.0488	2600.3799	1626.7495	867.8339	940.8698	1847.8402	2237.5729	1934.5226	1760.3160 (95)
Ext temp.	5.0000	5.6000	7.4000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.7000	7.9000	5.0000 (96)
Heat loss rate W	6008.2035	5751.7628	5049.5365	4007.6518	2811.5568	1640.3517	868.3774	942.1686	1943.6116	3343.9017	4805.4465	5964.4836 (97)
Space heating kwh	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98a)
Space heating requirement - total per year (kWh/year)												13948.0459
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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13948.0459
Space heating per m2										(98c) / (4) =		32.4902 (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 %)												332.9016 (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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98)
Space heating efficiency (main heating system 1)	332.9016	332.9016	332.9016	332.9016	332.9016	0.0000	0.0000	0.0000	0.0000	332.9016	332.9016	332.9016 (210)
Space heating fuel (main heating system)	911.7839	695.9543	517.4365	209.7058	47.1958	0.0000	0.0000	0.0000	0.0000	247.2528	620.9237	939.5871 (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	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400 (216)
Fuel for water heating, kWh/month	317.6200	281.4926	300.2062	266.3087	259.8456	209.3278	206.4903	214.6438	216.9656	269.4949	284.0164	314.4260 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-60.5232	-85.9015	-140.1329	-180.6390	-203.4575	-202.1840	-197.8100	-180.9466	-149.4547	-113.0034	-68.3060	-48.8748 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.8327	-6.2506	-16.6466	-36.6221	-57.5565	-70.9861	-68.8851	-56.0463	-36.9755	-14.5545	-4.3096	-1.9228 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												4189.8400 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												114.8400
Water heating fuel used												3140.8381 (219)

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Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	615.5363 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2004.8221 (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	5941.3923 (238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4189.8400	18.3900	770.5116 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	18.3900	577.6001 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	615.5363	18.3900	113.1971 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1631.2337	18.3900	-299.9839
PV Unit electricity exported	-373.5884	5.8100	-21.7055
Total			-321.6894 (252)
Total energy cost			1139.6195 (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	4189.8400	0.1565	655.8976 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3140.8381	0.1415	444.4631 (264)
Space and water heating			1100.3607 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1631.2337	0.1325	-216.1054
PV Unit electricity exported	-373.5884	0.1176	-43.9412
Total			-260.0465 (269)
Total CO2, kg/year			929.1551 (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	4189.8400	1.5796	6618.0686 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3140.8381	1.5233	4784.4360 (278)
Space and water heating			11402.5046 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1631.2337	1.4895	-2429.7165
PV Unit electricity exported	-373.5884	0.4312	-161.0801
Total			-2590.7966 (283)
Total Primary energy kWh/year			9755.8382 (286)

SAP 10 EPC IMPROVEMENTS

00001

Current energy efficiency rating: B 86
Current environmental impact rating: A 97

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

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Recommended measures:
N Solar water heating

SAP change + 1.0 Cost change -£ 99 CO2 change -69 kg (7.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£99 0.16 kg/m²	B 87	A 97
Total Savings	£99 0.16 kg/m²		

Potential energy efficiency rating: B 87
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£1461	£1359	£102
Space heating	£771	£785	-£15
Water heating	£578	£461	£117
Lighting	£113	£113	£0
Generated (PV)	-£322	-£318	-£3
Total cost of fuels	£1139	£1041	£99
Total cost of uses	£1140	£1041	£99
Delivered energy	14 kWh/m²	13 kWh/m²	1 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.1 tonnes
CO2 emissions per m²	2 kg/m²	2 kg/m²	0 kg/m²
Primary energy	23 kWh/m²	21 kWh/m²	2 kWh/m²

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 (m²)	Storey height (m)	Volume (m³)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1120.1008 (5)

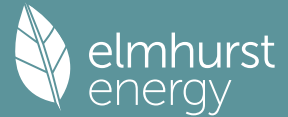
2. Ventilation rate

	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	8 * 10 = 80.0000 (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) =	80.0000 / (5) =	0.0714 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3214 (18)
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3074	0.3210 (22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515 (25)

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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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998
E3 Sill	33.3000	0.0190	0.6327
E4 Jamb	55.4000	0.0060	0.3324
E5 Ground floor (normal)	59.7000	0.0930	5.5521
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000
E16 Corner (normal)	42.0000	0.0350	1.4700
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.5070 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			(33) + (36) + (36a) = 189.3669 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	207.2426	206.3718	205.5182	201.5089	200.7588	197.2669	197.2669	196.6202	198.6119	200.7588	202.2763	203.8627	(38)
Average = Sum(39)m / 12 =	396.6095	395.7387	394.8851	390.8759	390.1258	386.6338	386.6338	385.9872	387.9789	390.1258	391.6432	393.2297	(39)
													390.8723
HLP	0.9239	0.9218	0.9198	0.9105	0.9087	0.9006	0.9006	0.8991	0.9037	0.9087	0.9123	0.9160	(40)
HLP (average)													0.9105
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3000 (42)
Hot water usage for mixer showers													
	79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	(42a)
Hot water usage for baths													
	36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	(42b)
Hot water usage for other uses													
	50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	(42c)
Average daily hot water use (litres/day)													153.1900 (43)
Daily hot water use													
	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372	(44)
Energy conte	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													2544.4469
	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431	(46)
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.4820 (55)
Total storage loss													
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(56)
If cylinder contains dedicated solar storage													
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.8000 (H2)
Collector linear heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0000 (H4)

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Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												660.5488 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												660.5488
Solar input	-0.0000	-16.1562	-60.2887	-84.9834	-114.3648	-103.6845	-103.2914	-88.9538	-59.8418	-28.9844	-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	364.7548	307.1100	284.4682	220.8456	184.0419	136.7075	133.8421	157.5432	189.3216	280.5036	326.1644	361.0868 (64)
												Total per year (kWh/year) = Sum(64)m = 2946.3896 (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												
	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316 (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	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001 (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)												
	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008 (71)
Water heating gains (Table 5)												
	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113 (72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108 (73)

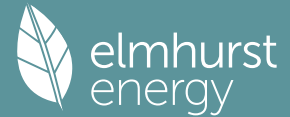
6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				34.6500	10.6334		0.7600		0.7000		0.7700		135.8376 (74)
South				21.8400	46.7521		0.7600		0.7000		0.7700		376.4422 (78)
East				3.0000	25.9287		0.7600		0.7000		1.0000		37.2440 (82)
South				6.0000	26.0000		0.7600		0.7000		1.0000		74.6928 (82)
Solar gains	624.2166	1105.7542	1629.1826	2219.0292	2672.4276	2736.3998	2603.4375	2251.7371	1830.9564	1253.1072	755.3216	529.2912	(83)
Total gains	1842.4697	2319.8156	2801.2109	3316.7169	3691.8807	3653.2833	3481.0807	3134.6940	2754.9752	2281.7263	1866.6139	1711.7020	(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, n11,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.3948	57.5211	57.6454	58.2367	58.3487	58.8757	58.8757	58.9743	58.6716	58.3487	58.1226	57.8881
alpha	4.8263	4.8347	4.8430	4.8824	4.8899	4.9250	4.9250	4.9316	4.9114	4.8899	4.8748	4.8592
util living area	0.9985	0.9952	0.9837	0.9397	0.8229	0.6417	0.4812	0.5510	0.8187	0.9729	0.9964	0.9990 (86)
Living	19.7752	19.9498	20.2148	20.5440	20.7930	20.9054	20.9308	20.9254	20.8342	20.4893	20.0646	19.7461
Non living	18.6807	18.9053	19.2438	19.6595	19.9480	20.0649	20.0835	20.0821	20.0018	19.5999	19.0592	18.6486
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (88)
util rest of house	0.9981	0.9939	0.9794	0.9236	0.7806	0.5705	0.3937	0.4583	0.7593	0.9628	0.9953	0.9987 (89)
MIT 2	20.1473	20.1490	20.1507	20.1586	20.1601	20.1670	20.1670	20.1683	20.1643	20.1601	20.1571	20.1539 (90)
Living area fraction												fLA = Living area / (4) = 0.2182 (91)
MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3334	20.3347	20.3360	20.3422	20.3434	20.3488	20.3488	20.3498	20.3467	20.3434	20.3410	20.3386 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9942	0.9804	0.9275	0.7905	0.5866	0.4131	0.4791	0.7736	0.9653	0.9956	0.9987	(94)
Useful gains	1839.1535	2306.4268	2746.4015	3076.1664	2918.5269	2143.1708	1438.0291	1501.8549	2131.1382	2202.6184	1858.3897	1709.5551	(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	6358.9801	6108.1057	5463.6343	4472.4787	3371.9958	2222.6636	1449.3959	1524.5556	2423.5779	3801.1341	5185.7527	6346.1621	(97)
Space heating kWh	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98a)
Space heating requirement - total per year (kWh/year)												16316.4589	
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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16316.4589	
Space heating per m2												38.0071	(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 %)													332.9430 (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	3362.7510	2554.7282	2021.6212	1005.3449	337.3809	0.0000	0.0000	0.0000	0.0000	1189.2957	2395.7014	3449.6356	(98)
Space heating efficiency (main heating system 1)	332.9430	332.9430	332.9430	332.9430	332.9430	0.0000	0.0000	0.0000	0.0000	332.9430	332.9430	332.9430	(210)
Space heating fuel (main heating system)	1010.0081	767.3170	607.1974	301.9571	101.3329	0.0000	0.0000	0.0000	0.0000	357.2070	719.5530	1036.1040	(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	364.7548	307.1100	284.4682	220.8456	184.0419	136.7075	133.8421	157.5432	189.3216	280.5036	326.1644	361.0868	(64)
Efficiency of water heater	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	(216)
Fuel for water heating, kWh/month	317.6200	267.4242	247.7083	192.3072	160.2594	119.0418	116.5466	137.1849	164.8568	244.2560	284.0164	314.4260	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-52.5910	-85.2961	-139.3827	-174.7659	-199.4308	-185.2684	-182.7065	-165.8847	-137.5214	-104.9012	-61.5092	-44.2304	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.1034	-5.9732	-16.0594	-33.5572	-57.9348	-67.7630	-66.9810	-52.2685	-33.3363	-11.7745	-3.3663	-1.5395	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4900.6765	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												2565.6475	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												615.5363	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV generation												-1886.1454	(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												6275.7149	(238)

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10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4900.6765	16.4900	808.1216 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2565.6475	16.4900	423.0753 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	615.5363	16.4900	101.5019 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1533.4882	16.4900	-252.8722
PV Unit electricity exported	-352.6573	5.5900	-19.7135
Total			-272.5857 (252)
Total energy cost			1073.3050 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8147 (257)
SAP value		86.7945
SAP rating (Section 12)		87 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4900.6765	0.1557	762.9767 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2565.6475	0.1447	371.1691 (264)
Space and water heating			1134.1458 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1533.4882	0.1327	-203.4950
PV Unit electricity exported	-352.6573	0.1172	-41.3356
Total			-244.8306 (269)
Total CO2, kg/year			989.2531 (272)
CO2 emissions per m2			2.3000 (273)
EI value			97.2051
EI rating			97 (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

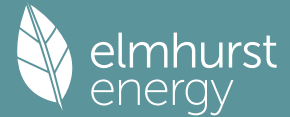
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	201.9200 (1b)	x 2.5400 (2b)	= 512.8768 (1b) -
First floor	139.8000 (1c)	x 2.8400 (2c)	= 397.0320 (1c) -
Second floor	87.5800 (1d)	x 2.4000 (2d)	= 210.1920 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	429.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1120.1008 (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)

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Number of flues attached to other heater
 Number of blocked chimneys
 Number of intermittent extract fans
 Number of passive vents
 Number of flueless gas fires

0 * 35 = 0.0000 (6e)
 0 * 20 = 0.0000 (6f)
 8 * 10 = 80.0000 (7a)
 0 * 10 = 0.0000 (7b)
 0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =
 Pressure test
 Pressure Test Method
 Measured/design AP50
 Infiltration rate
 Number of sides sheltered

Air changes per hour
 80.0000 / (5) = 0.0714 (8)
 Yes
 Blower Door
 5.0000 (17)
 0.3214 (18)
 2 (19)

Shelter factor
 Infiltration rate adjusted to include shelter factor

(20) = 1 - [0.075 x (19)] = 0.8500 (20)
 (21) = (18) x (20) = 0.2732 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.7000	3.7000	3.4000	3.5000	3.8000	3.7000	4.1000	(22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.9250	0.9250	0.8500	0.8750	0.9500	0.9250	1.0250	(22a)
Adj infilt rate	0.3074	0.2937	0.2937	0.2664	0.2732	0.2527	0.2527	0.2322	0.2391	0.2595	0.2527	0.2800	(22b)
Effective ac	0.5472	0.5431	0.5431	0.5355	0.5373	0.5319	0.5319	0.5270	0.5286	0.5337	0.5319	0.5392	(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 = 1.20)			56.4900	1.1450	64.6832			(27)
Opening			6.0000	1.1450	6.8702			(27a)
Opening			3.0000	1.1450	3.4351			(27a)
Heatloss Floor 1			201.9200	0.1300	26.2496	110.0000	22211.2000	(28a)
External Wall 1	280.0500	56.4900	223.5600	0.1800	40.2408	190.0000	42476.4000	(29a)
External Wall 2	17.1900		17.1900	0.1800	3.0942	190.0000	3266.1000	(29a)
External Wall 3	60.9900		60.9900	0.1800	10.9782	9.0000	548.9100	(29a)
External Roof 1	36.8300	9.0000	27.8300	0.1400	3.8962	9.0000	250.4700	(30)
External Roof 2	61.9100		61.9100	0.1400	8.6674	9.0000	557.1900	(30)
External Roof 3	79.5000		79.5000	0.1100	8.7450	9.0000	715.5000	(30)
Total net area of external elements Aum(A, m2)			738.3900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 176.8599			(33)
Internal Wall 1			566.3900			9.0000	5097.5100	(32c)
Internal Floor 1			132.1200			18.0000	2378.1600	(32d)
Internal Floor 2			84.2400			18.0000	1516.3200	(32d)
Internal Ceiling 1			193.4600			9.0000	1741.1400	(32e)
Internal Ceiling 2			132.1200			9.0000	1189.0800	(32e)

Heat capacity Cm = Sum(A x k)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
 (28)...(30) + (32) + (32a)...(32e) = 81947.9800 (34)
 190.8874 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	33.3000	0.0060	0.1998
E3 Sill	33.3000	0.0190	0.6327
E4 Jamb	55.4000	0.0060	0.3324
E5 Ground floor (normal)	59.7000	0.0930	5.5521
E6 Intermediate floor within a dwelling	49.7900	0.0000	0.0000
E16 Corner (normal)	42.0000	0.0350	1.4700
R11 Upstands or kerbs of rooflights	18.0000	0.2400	4.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K)
 Point Thermal bridges
 Total fabric heat loss
 (33) + (36) + (36a) = 189.3669 (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	202.2763	200.7588	200.7588	197.9308	198.6119	196.6202	196.6202	194.7837	195.3786	197.2669	196.6202	199.3103	(38)
Heat transfer coeff	391.6432	390.1258	390.1258	387.2977	387.9789	385.9872	385.9872	384.1507	384.7456	386.6338	385.9872	388.6772	(39)
Average = Sum(39)m / 12 =												387.4450	

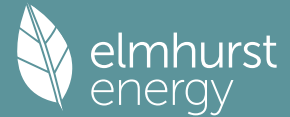
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9123	0.9087	0.9087	0.9022	0.9037	0.8991	0.8991	0.8948	0.8962	0.9006	0.8991	0.9054	(40)
HLP (average)												0.9025	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3000 (42)
Hot water usage for mixer showers													
79.5504	78.3549	76.6129	73.2798	70.8200	68.0769	66.5177	68.2466	70.1418	73.0870	76.4917	79.2456	79.2456	(42a)
Hot water usage for baths													
36.1395	35.6028	34.8469	33.4534	32.4098	31.2528	30.6278	31.3783	32.1955	33.4336	34.8559	36.0173	36.0173	(42b)
Hot water usage for other uses													
50.9742	49.1206	47.2670	45.4134	43.5598	41.7062	41.7062	43.5598	45.4134	47.2670	49.1206	50.9742	50.9742	(42c)
Average daily hot water use (litres/day)												153.1900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													

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Energy conte	166.6641	163.0783	158.7268	152.1465	146.7896	141.0359	138.8517	143.1847	147.7507	153.7876	160.4682	166.2372 (44)
Energy content (annual)	263.9552	232.2213	243.9572	208.2810	197.6071	173.4200	167.9291	177.2926	182.1913	208.6884	228.6164	260.2872 (45)
Distribution loss (46)m = 0.15 x (45)m												2544.4469
	39.5933	34.8332	36.5936	31.2421	29.6411	26.0130	25.1894	26.5939	27.3287	31.3033	34.2925	39.0431 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9000 (48)
Temperature factor from Table 2b												0.7800 (49)
Enter (49) or (54) in (55)												1.4820 (55)
Total storage loss												
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (56)
If cylinder contains dedicated solar storage												
	45.9420	41.4960	45.9420	44.4600	45.9420	44.4600	45.9420	45.9420	44.4600	45.9420	44.4600	45.9420 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	364.7548	323.2661	344.7568	305.8290	298.4067	240.3920	237.1335	246.4970	249.1633	309.4880	326.1644	361.0868 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												729.7645 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												729.7645
Solar input	-0.0000	-17.5861	-62.3917	-91.5176	-118.2153	-115.3721	-113.6481	-100.9242	-70.1493	-37.5927	-2.3675	-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												
	364.7548	305.6801	282.3652	214.3113	180.1914	125.0199	123.4854	145.5727	179.0141	271.8953	323.7970	361.0868 (64)
												Total per year (kWh/year) = Sum(64)m = 2877.1740 (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												
	131.6512	116.8526	125.0019	111.7238	109.5904	75.6718	74.4463	77.5597	78.5882	113.2750	118.4854	130.4316 (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)
(66)m	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	198.0012	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	87.1355	77.3930	62.9402	47.6498	35.6188	30.0709	32.4926	42.2352	56.6880	71.9784	84.0094	89.5573	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	830.0665	838.6799	816.9742	770.7653	712.4349	657.6125	620.9877	612.3742	634.0800	680.2889	738.6193	793.4417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	58.1001	(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)	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	-132.0008	(71)
Water heating gains (Table 5)	176.9505	173.8879	168.0132	155.1720	147.2990	105.0997	100.0623	104.2469	109.1503	152.2513	164.5630	175.3113	(72)
Total internal gains	1218.2531	1214.0614	1172.0282	1097.6876	1019.4531	916.8835	877.6432	882.9568	924.0188	1028.6191	1111.2923	1182.4108	(73)

6. Solar gains

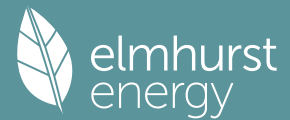
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	34.6500	12.3808	0.7600	0.7000	0.7700	158.1603 (74)
South	21.8400	52.6843	0.7600	0.7000	0.7700	424.2080 (78)
East	3.0000	30.6234	0.7600	0.7000	1.0000	43.9874 (82)
South	6.0000	31.0000	0.7600	0.7000	1.0000	89.0568 (82)

Solar gains	715.4125	1106.4472	1635.1565	2314.8067	2719.0408	2966.0787	2791.1278	2450.4112	1992.2816	1359.4931	836.7843	581.0604 (83)
Total gains	1933.6656	2320.5086	2807.1848	3412.4944	3738.4940	3882.9623	3668.7710	3333.3681	2916.3003	2388.1122	1948.0766	1763.4712 (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)	

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.1226	58.3487	58.3487	58.7748	58.6716	58.9743	58.9743	59.2562	59.1646	58.8757	58.9743	58.5661
alpha	4.8748	4.8899	4.8899	4.9183	4.9114	4.9316	4.9316	4.9504	4.9443	4.9250	4.9316	4.9044
util living area	0.9978	0.9941	0.9786	0.9086	0.7393	0.4798	0.3045	0.3558	0.6962	0.9509	0.9944	0.9985 (86)
Living	19.8814	20.0355	20.3136	20.6542	20.8635	20.9303	20.9367	20.9363	20.8976	20.6139	20.1760	19.8505
Non living	18.8243	19.0237	19.3765	19.7974	20.0241	20.0843	20.0876	20.0913	20.0649	19.7585	19.2103	18.7894
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (88)
util rest of house	0.9972	0.9925	0.9726	0.8845	0.6825	0.4016	0.2175	0.2616	0.6148	0.9323	0.9926	0.9981 (89)
MIT 2	20.1571	20.1601	20.1601	20.1657	20.1643	20.1683	20.1683	20.1719	20.1707	20.1670	20.1683	20.1629 (90)
Living area fraction									fLA = Living area / (4) =			0.2182 (91)
MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3410	20.3434	20.3434	20.3477	20.3467	20.3498	20.3498	20.3526	20.3517	20.3488	20.3498	20.3456 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9973	0.9929	0.9740	0.8903	0.6956	0.4189	0.2365	0.2823	0.6336	0.9370	0.9930	0.9982 (94)
Useful gains	1928.4407	2304.0793	2734.2748	3038.0488	2600.3799	1626.7495	867.8339	940.8698	1847.8402	2237.5729	1934.5226	1760.3160 (95)
Ext temp.	5.0000	5.0000	7.4000	10.0000	13.1000	16.1000	18.1000	17.9000	15.3000	11.7000	7.9000	5.0000 (96)
Heat loss rate W	6008.2035	5751.7628	5049.5365	4007.6518	2811.5568	1640.3517	868.3774	942.1686	1943.6116	3343.9017	4805.4465	5964.4836 (97)
Space heating kWh	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98a)
Space heating requirement - total per year (kWh/year)												13948.0459
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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13948.0459
Space heating per m2										(98c) / (4) =		32.4902 (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 %)												332.9016 (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	3035.3435	2316.8434	1722.5547	698.1141	157.1156	0.0000	0.0000	0.0000	0.0000	823.1086	2067.0652	3127.9008 (98)
Space heating efficiency (main heating system 1)	332.9016	332.9016	332.9016	332.9016	332.9016	0.0000	0.0000	0.0000	0.0000	332.9016	332.9016	332.9016 (210)
Space heating fuel (main heating system)	911.7839	695.9543	517.4365	209.7058	47.1958	0.0000	0.0000	0.0000	0.0000	247.2528	620.9237	939.5871 (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	364.7548	305.6801	282.3652	214.3113	180.1914	125.0199	123.4854	145.5727	179.0141	271.8953	323.7970	361.0868 (64)
Efficiency of water heater (217)m	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400	114.8400 (216)
Fuel for water heating, kWh/month	317.6200	266.1791	245.8770	186.6173	156.9064	108.8645	107.5282	126.7613	155.8813	236.7601	281.9549	314.4260 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	76.2692	61.1860	55.0912	40.3622	31.1769	25.4718	28.4406	36.9682	48.0180	63.0023	71.1609	78.3890 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-60.5307	-85.8750	-139.7382	-178.8154	-198.8295	-195.4578	-191.3014	-176.3447	-147.4623	-112.7508	-68.3155	-48.8798 (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	-2.8253	-6.2771	-17.0413	-38.4457	-62.1845	-77.7122	-75.3936	-60.6482	-38.9679	-14.8071	-4.3001	-1.9177 (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)												

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(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												4189.8400	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												114.8400	
Water heating fuel used												2505.3762	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												615.5363	(232)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2004.8221	(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												5385.9303	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4189.8400	18.3900	770.5116 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2505.3762	18.3900	460.7387 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	18.3900	14.7120 (249)
Energy for lighting	615.5363	18.3900	113.1971 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1604.3013	18.3900	-295.0310
PV Unit electricity exported	-400.5208	5.8100	-23.2703
Total			-318.3013 (252)
Total energy cost			1040.8581 (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	4189.8400	0.1565	655.8976 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2505.3762	0.1451	363.6180 (264)
Space and water heating			1019.5156 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	615.5363	0.1443	88.8409 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1604.3013	0.1327	-212.8501
PV Unit electricity exported	-400.5208	0.1171	-46.8810
Total			-259.7311 (269)
Total CO2, kg/year			859.7224 (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	4189.8400	1.5796	6618.0686 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2505.3762	1.5369	3850.4165 (278)
Space and water heating			10468.4851 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	615.5363	1.5338	944.1302 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1604.3013	1.4902	-2390.7794
PV Unit electricity exported	-400.5208	0.4290	-171.8315
Total			-2562.6109 (283)
Total Primary energy kWh/year			8971.0284 (286)