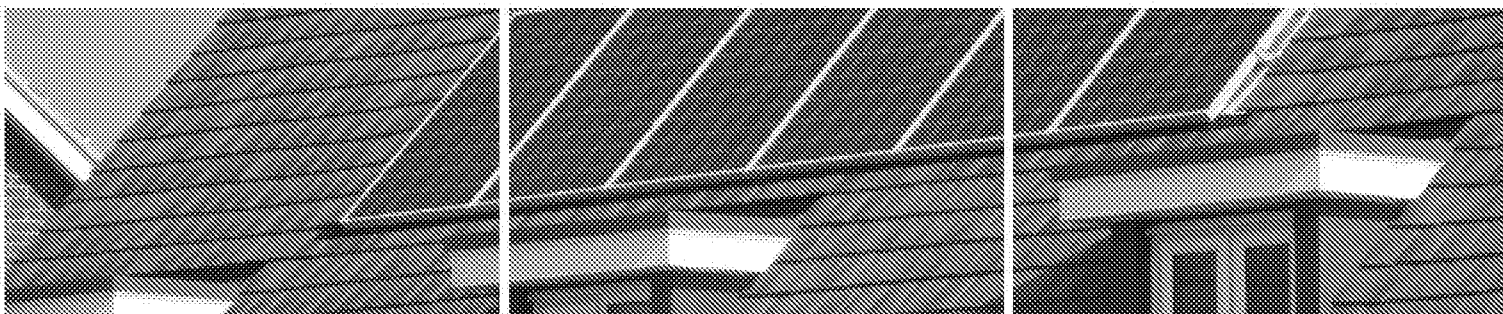
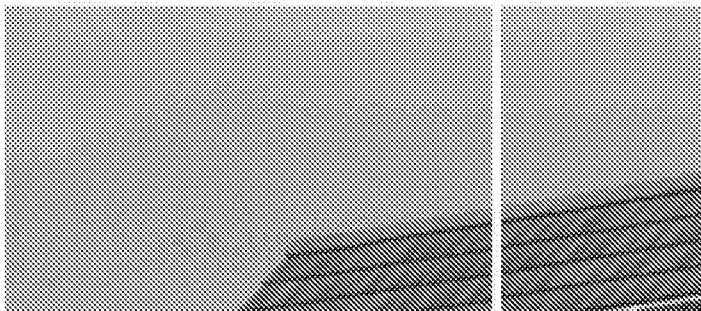
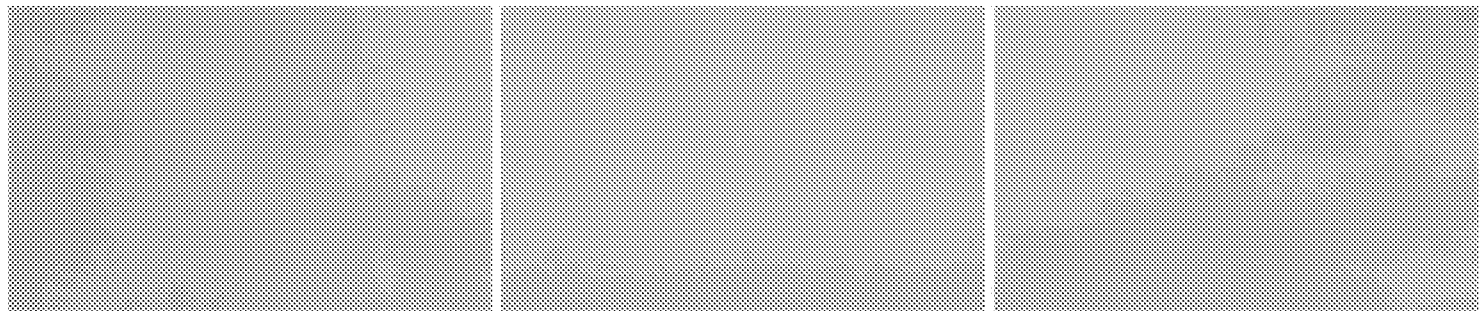


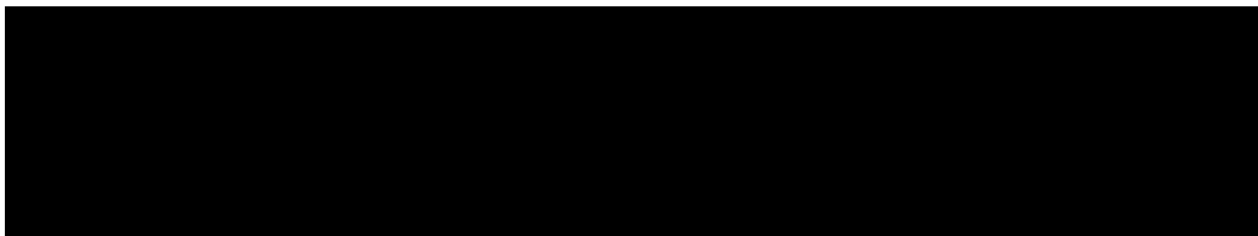
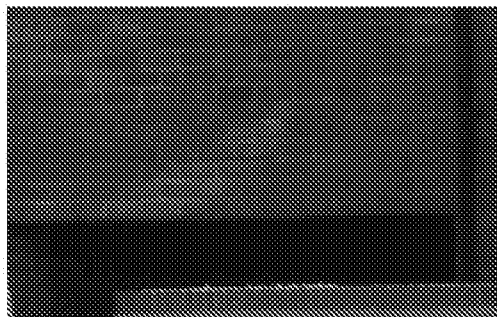


Energy Demand Study

Drove Lane, Yapton

Client: Barratt Southern Counties

Author: Andrew Maughan



Revision History

<i>Version</i>	<i>Date Issued</i>	<i>Issued by</i>	<i>QA Check</i>
1	29/01/2021	 <i>Andrew Maughan</i>	 <i>Michael Woodbridge</i>
2	22/10/2021	 <i>Andrew Maughan</i>	 <i>William Vincent</i>

About Environmental Economics

Our team of experienced consultants specialise in construction and building energy. We have qualifications in sustainability, energy, engineering, building physics and construction as well as environmental, quality management and auditing.

Over the last decade, we have provided assessments and consultancy for some of the largest UK house builders, including Barratt Developments, David Wilson Homes, Bellway Homes, Abbey New Homes and Davidsons. We develop flexible, practical, cost-effective specifications for our clients through identifying solutions and delivering design advice. This includes the following disciplines:

- *Overheating Analysis (dynamic thermal modelling)*
- *Daylighting / Sunlight Simulations*
- *Energy Reports*
- *Compliance assessments and advice covering*
 - *Part L (SAP)*
 - *Part F (ventilation)*
 - *Part G (water)*
- *BREEAM*
- *SBEM (existing and new build)*
- *Minimum Energy Efficiency Standards (MEES)*
- *Thermal Bridging (Psi value calculations)*

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1. Project Overview

1.1. Introduction

- 1.1.1. This energy demand study was prepared by Environmental Economics Ltd on behalf of Barratt Homes Southern Counties. The report assesses measures to reduce the energy demand of the domestic housing on site through the use of fabric efficiency and renewables.

1.2. Description of Site

- 1.2.1. The site consists of 300 plots. These units comprise a range of detached, semi-detached and terraced houses, as well as a number of maisonettes.
- 1.2.2. The proposed site location/boundary for the whole site is shown in Appendix A.
- 1.2.3. This report addresses a domestic development being undertaken by Barratt Southern Counties, and does not include any further proposals for subsequent developments or non-residential parcels.

1.3. Client Brief

- 1.3.1. The development has been designed to achieve a 10% reduction in energy demand, beyond the minimum standard set by current building regulations in line with Condition 22 of the Outline Planning Permission (Ref. Y/92/17/OUT) as described below:

"Before development commences on any phase a scheme identifying the principles to be incorporated into detailed building design as the means of energy conservation, together with onsite energy renewable devices for that phase, shall be submitted to and agreed with the Local Planning Authority. Such scheme as is submitted shall seek as a target the provision of on-site renewable energy which will generate an estimated 10% of annual energy requirements of the buildings granted planning permission. In determining the provision of on-site energy generation account will be taken of the impact on the viability of the development. Such scheme as is approved will be implemented in accordance with the scheme for that phase."

1.4. Building regulations

- 1.4.1. The SAP assessments have been undertaken using the appropriate legislative guidance; Approved Document Part L1A 2013. It should be noted that future policies and building regulations will reflect changes to the carbon content of fuels. In particular grid electricity is expected to become significantly decarbonized due to the ongoing investment in wind, solar and nuclear energy.
- 1.4.2. If the project is determined to fall under the new regulations in the future, then some modifications may be needed to the solutions. However, as it stands the project is being assessed under the current regulations and this report displays a method of achieving the required reduction as per the above planning condition. Currently, it is expected that Approved Document L will be updated in late 2021, and to be enforced in 2022.

2. Improvement Measures

2.1. Assessment Methodology

2.1.1. Environmental Economics have modelled the proposed dwellings using NHER Plan Assessor software. The software provides a number of outputs which can be used to assess and compare the improvements from any number of build specifications in terms of:

- *Building regulations compliance*
- *Energy usage per year (kWh/annum)*
- *Carbon emissions as a measure of building regulations compliance (kg CO₂/m²/year)*
- *Energy costs per year (£/annum)*
- *More detailed breakdowns by end use (space heating, water heating, cooking, lighting, appliances)*
- *Code for Sustainable Homes compliance*
- *Effective air change rate*

2.1.2. Each of these outputs can be used in different ways to analyse the performance of the dwelling. The total regulated carbon emissions for each property is based upon:

- *Space heating*
- *Water heating*
- *Electricity for pumps and fans*
- *Electricity for lighting*

2.1.3. Two models were created in order to calculate the energy demand. The required data for the site is calculated for each of the models, and then the difference used to establish the level of improvement. In order to achieve this representative house types have been utilised.

2.1.4. The emissions calculation for the space and water heating, as well as the electricity for pumps, fans and lighting were all assessed using the Standard Assessment Procedure (SAP 2012) through version 6 of the NHER Plan Assessor software. An example SAP worksheet is shown in Appendix D.

2.2. Design Philosophy

2.2.1. Upgrades have been made to a number of elements from a standard build specification in order to improve energy efficiency across the development. The site adopts the good design principles endorsed and promoted by The Zero Carbon Hub, the construction industries' key advisors and partners with the Governments Communities and Local Government Department. This guidance follows the general good principles of energy efficiency as the industry moves towards zero carbon. The principles are illustrated in figure 1 below.

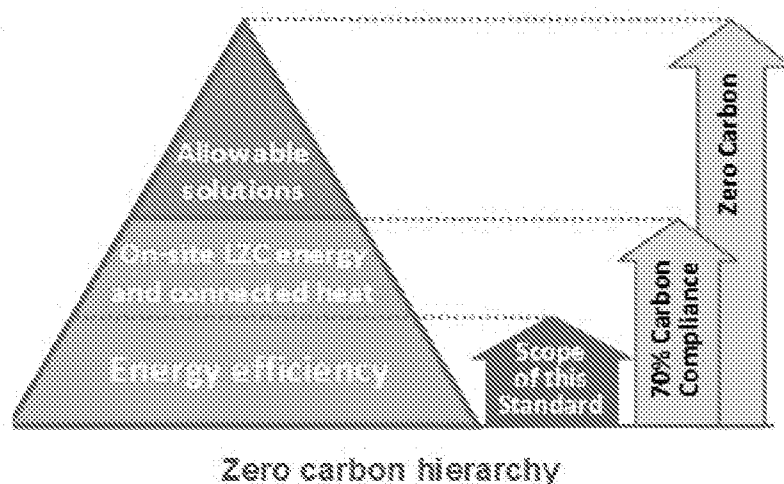


Figure 1

2.2.2. In order to reduce the residual carbon emissions a number of improvements were made to the standard material and product specification. These improvements include:

- *Upgraded heating and hot water controls*
- *Delayed start thermostat*
- *Design air permeability of 5.01m³/hr/m²*
- *Bespoke thermal bridging details*

2.3. Product Improvements

- 2.3.1. The systems used in a property to supply hot water and heating, as well as control it, are important to the overall energy demand of a property. The 2013 Building Regulations state that all systems and their controls must adhere to the minimum standards shown in Domestic Heating Compliance Guide.
- 2.3.2. For a mains gas fired system the minimum boiler efficiency required is 86%. High efficiency condensing boilers have been specified throughout the site for both combination and cylinder based systems. These boilers achieve a SAP 2009 rated efficiency of at least 89% and are recommended by the Energy Saving Trust.
- 2.3.3. Where installed, hot water cylinders can lose a significant amount of energy. In order to minimise this energy loss and corresponding carbon emissions, cylinders which have higher levels of insulation in comparison to typical hot water cylinders will be used.
- 2.3.4. Finally 100% Low-E lighting fixtures shall be fitted to all properties.

2.4. Fabric Improvements

2.4.1. The building fabric for all dwellings was improved from basic compliance with Part L1A 2013 to an enhanced specification. These fabric improvements reduce the space heating requirement upon a property. The improvements have been made through a combination of upgraded materials and increased insulation thicknesses. Enhanced glazing with a larger transmittance factor allowing for increased solar gains will also be used. Changes to the U-Value of external elements are shown in table 1 below.

<i>Element</i>	<i>Minimum Standard</i>	<i>Improved Specification</i>	
-	<i>W/m²k</i>	<i>Description</i>	<i>W/m²k</i>
Walls	0.30	50mm Alreflex Platinum Cavity	0.27
Roof	0.20	400mm Mineral Wool Horizontal Ceiling, Loft Space	0.11
		Flat Roof	0.17
Floors	0.25	Spantherm Advance	0.12 - 0.14
Doors	2.00	Double glazed Low-E, u-PVC frame	1.00 – 1.70
Glazing	2.00	Double glazed Low-E, u-PVC frame	1.3

Table 1

2.4.2. As improvements are made to the thermal conductivity of main elements, thermal bridging and air permeability becomes increasingly significant in the overall fabric performance. Bespoke thermal bridging designs have been utilised, which achieve much lower heat loss levels in comparison with standard practice.

2.4.3. As a result of following these junction details and focusing on build quality air permeability will also decrease. A target air pressure rating of 5.01m³/hr.m² has been set for all houses on site which is a 50% improvement on the maximum allowable rating in the 2013 Building Regulations.

2.5. Hi-Therm Lintels

- 2.5.1. As the latest set of building regulations have incorporated a Target Fabric Energy Efficiency (TFEE) standard for all new houses, some of the bespoke thermal bridging details would not be sufficient to achieve the latter.
- 2.5.2. Since a significant amount of heating energy is lost through the dwellings lintels, the Client intend to use IG Hi-Therm lintels on this site. IG Hi-Therm lintels achieve a lower linear thermal transmittance (Psi value) of 0.05W/mK, in comparison to the normal IG lintels which achieve a Psi value of 0.23W/mK. More details are shown in Appendix C.

3. Low and Zero Carbon Technologies

3.1. Photovoltaic (PV) Cells

3.1.1. The efficiency of PV cells has improved rapidly over the last 15 years. This has made a previously uneconomical technology an increasingly viable solution to rising energy costs and demand. The cells can be produced in a variety of formats but are typically manufactured as a panel or a roof tile for domestic housing applications.

3.1.2. The PV system typically produces direct current (DC) which is then sent through an inverter to supply the house with electricity. If a greater amount of electricity is produced than used by the household, this extra can be exported to the national grid, as can be seen in figure 2.

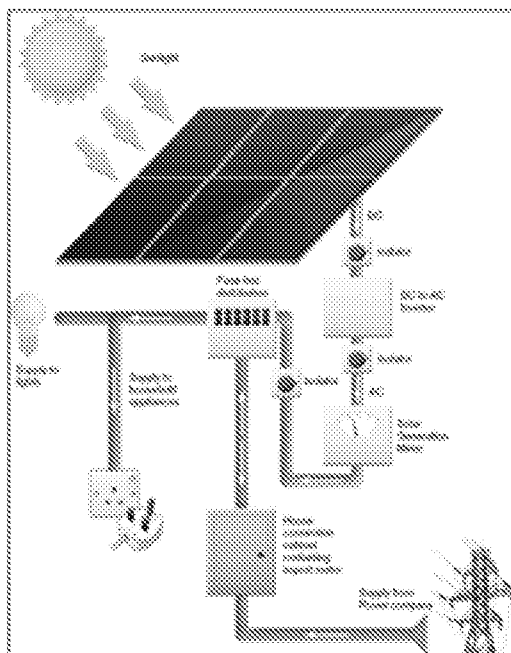


Figure 2

3.1.3. A PV cell is assessed on its peak power rating. This is tested by exposing the cell to the equivalent of full solar radiation and measuring the power output. The peak power is input into the NHER software as well as the physical attributes of the installation such as pitch, orientation and over-shading. A total energy saving per year can then be calculated through SAP for the PV installation. This is then offset against the electricity energy demand for the house.

3.2. Solar Hot Water (SHW)

- 3.2.1. SHW systems provide hot water to a household usually in conjunction with a conventional boiler and cylinder system. Because of this they are best suited to houses with a need for a cylinder hot water system rather than a combi boiler.
- 3.2.2. There are two main SHW systems; evacuated tubes and flat plate collectors. Evacuated tubes are more efficient at transferring solar irradiation to the fluid although flat plate collectors are considered to be better aesthetically and to install. An example of the latter can be seen in figure 3.



Figure 3

- 3.2.3. The final energy contribution to the household, calculated through SAP, is based on a number of factors:
- *Pitch, orientation and over-shading*
 - *Heat absorption efficiency for the collector*
 - *Average hot water usage of the dwelling*
- 3.2.4. The majority of the energy savings will be made in the hot water demand for the dwelling however, adding a SHW system will impact upon other energy demands.

3.3. Air Source Heat Pumps (ASHP)

- 3.3.1. ASHP provide heating and hot water to a home through thermal energy gathered from air outside the dwelling. Systems can be designed to work in conjunction with a boiler system but in the case of energy efficient new builds it is possible for an ASHP unit to provide 100% of the heating and hot water demand.

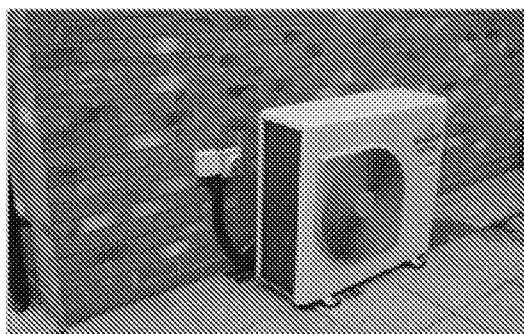


Figure 4

- 3.3.2. The thermal performance of the unit depends on the outside temperature as well as the unit's Coefficient of Performance. This is the ratio of thermal energy produced to energy used. A typical value for this would be around 3.5, meaning that for every 1kW of electricity consumed the unit would provide 3.5kW of thermal energy to the household. This efficiency leads to large carbon and energy savings for both space and water heating.
- 3.3.3. ASHP are assessed by their power output and the size of unit chosen depends on the demand from the household. An example external unit can be seen above in figure 4. The units with a larger power output can provide a larger amount of hotter water even in colder climates.

3.4. Ground Source Heat Pumps (GSHP)

- 3.4.1. GSHP provide heating and hot water to a dwelling through geothermal effects. A GSHP system would offset the energy demand from the main space heating. There is, however, an additional electricity demand for the pump and control system. This would reduce energy savings from the installation.

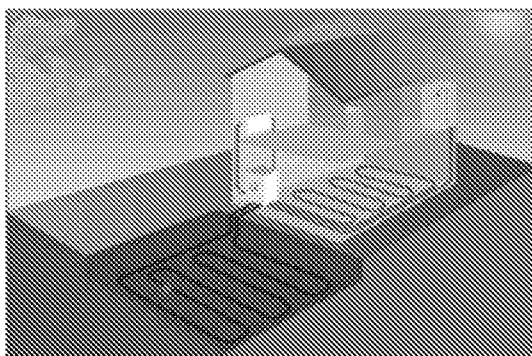


Figure 5

- 3.4.2. GSHP are expensive to install and rely on having appropriate ground conditions and suitable space around the dwelling for the pipe looping. Energy savings are dependent upon the type of system being replaced and the way the system is operated by the homeowner. A typical system can be seen above in figure 5.

3.5. Biomass Heating Systems

- 3.5.1. Biomass heating systems burn fuels, considered carbon neutral, to heat the water required for a dwelling. There are a large variety of systems available and choice depends on the type of fuel to be burned and the level of automation.
- 3.5.2. The system would offset the energy demand from the hot water and main space heating. However, biomass systems typically require a large amount of maintenance and monitoring. An example system can be seen in figure 6.

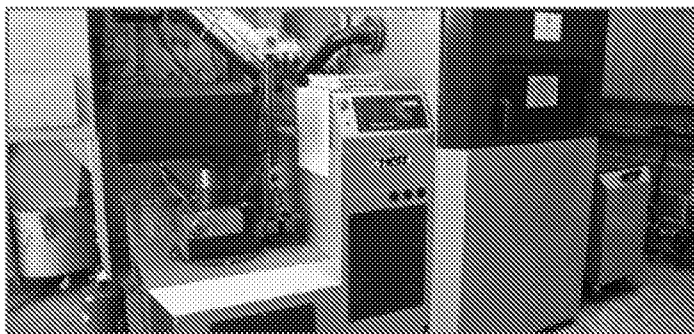


Figure 6

- 3.5.3. The savings from such a system, in terms of CO₂ and money, depends upon what it is replacing. The savings are greatest when replacing an electrical hot water system but are considerably less for replacing mains gas.

3.6. Wind Turbines

- 3.6.1. Wind turbines provide electricity directly to a dwelling. They can be added to a property in two ways: pole mounted or building mounted. The pole mounted systems are free standing and therefore require enough space around them to allow for the construction and maintenance of the structure, as well as to allow for efficient operation. The building mounted systems have a lower power output but do not require additional structures, as can be seen in figure 7.



Figure 7

- 3.6.2. The energy produced from a wind turbine is heavily dependent upon the surrounding landscape. The energy saved will be offset against the electricity usage of the dwelling.

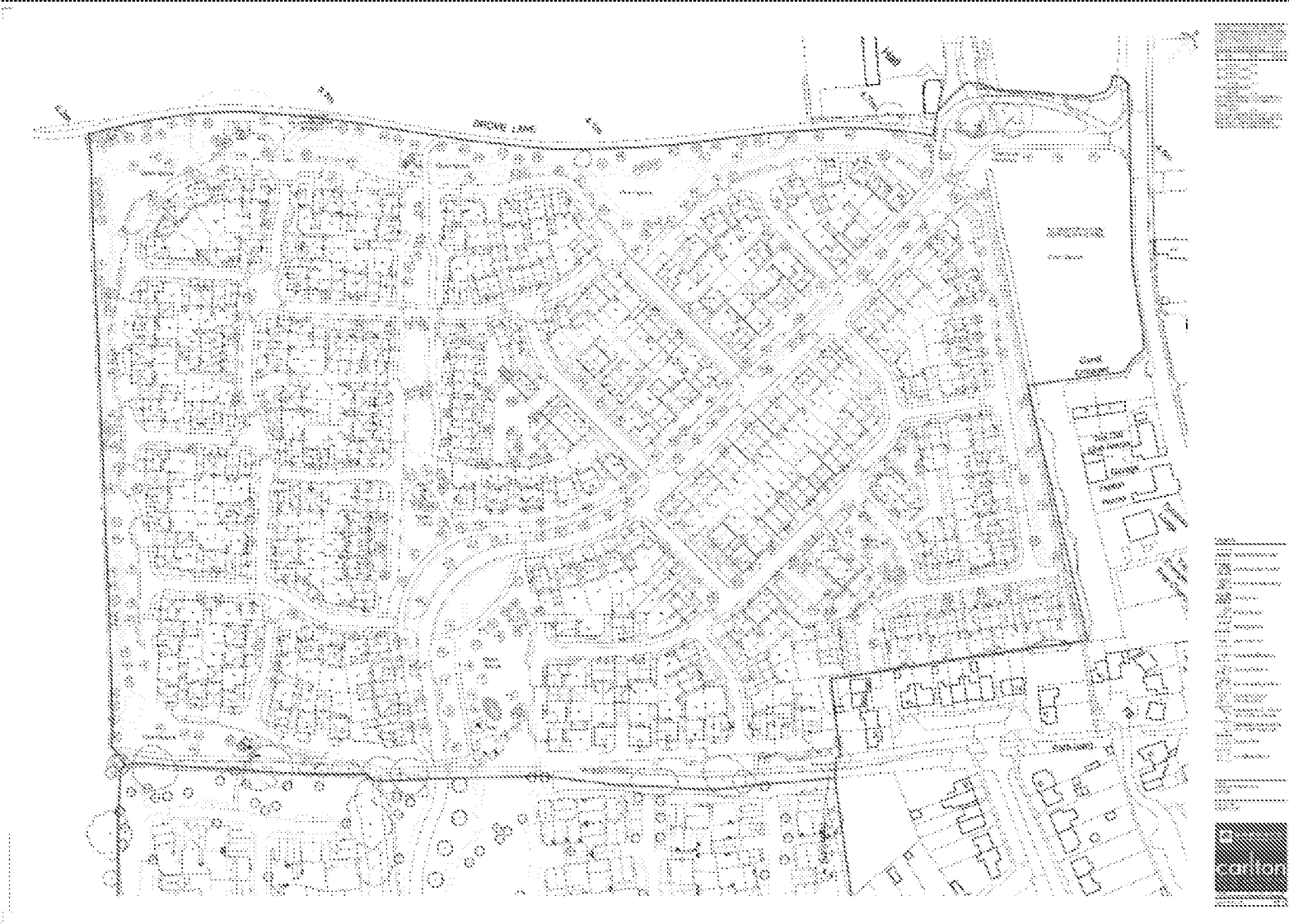
3.7. Comparison

- 3.7.1. SHW can be easily incorporated into new build house designs and has the potential to reduce the energy demand from hot water considerably.
- 3.7.2. The product and installation cost make ASHP an expensive option. There is also a degree of uncertainty about the energy saving that can be obtained from the system as it requires diligent operation. The same can be said of GSHP, as well as the fact that additional extensive ground work is required in order to make use of the system.
- 3.7.3. Biomass hot water systems are more suited to the replacement of inefficient, carbon heavy systems such as electrical immersion heaters. The requirement of maintenance and monitoring makes it unsuitable for large scale new build developments
- 3.7.4. The density of the site is a major restriction on the potential energy that could be generated from wind turbines. Surrounding houses and the urban location would restrict wind speeds.
- 3.7.5. The solution of PV panel systems will be used. 84.60 kWp with an average orientation of South East/South West would be sufficient to aid in achieving the 10% energy demand target.
- 3.7.6. For the purpose of the report this amount of PV has been distributed amongst the Moresby and H486 (Hollinwood) house types.
- 3.7.7. However, the PV may be distributed differently, as long as the total reduction in carbon emissions remains the same.

4. Conclusion

- 4.1.1. The table presented in Appendix B shows reduction in energy demand achieved via fabric efficiency measures and renewables.
- 4.1.2. The energy demand for the baseline compliance model for the site is 1,870,690 kWh/Annum. After the proposed improvements this energy demand is reduced to 1,683,390 kWh/Annum. This constitutes a 10.0% reduction over current building regulations.

Appendix A



Appendix B

Energy Demand Reduction Study Drove Lane, Yapton

Client:	Barratt Southern Counties					 environmental economics		
Project:	Drove Lane, Yapton							
Report:	Energy Reduction from Fabric Improvements and On-Site Renewable Energy Generation							
House Type/ Plot Number	Space Heating Requirement	Hot Water Requirement	Lighting Requirement	Pumps and Fans Requirement	PV Contribution	SAP Floor Area	Number of Plots	Total Energy Demand ²¹
-	kWh/Annum	kWh/Annum	kWh/Annum	kWh/Annum	kWh/Annum	m ²	-	kWh/Annum
Data Set 1: Base Case Design (Part L 2013 Compliant)								
2BF Det	3955	1621	297	75	-	60	1	5,948
2BF ET	3802	1622	297	75	-	60	1	5,795
Alverton CL Mid	3299	1623	299	75	-	60	1	5,296
Bewdley Det	4666	1891	375	75	-	90	7	49,056
Blyford Det	4666	1891	375	75	-	90	10	70,078
Denford DS00 EOT	2511	1587	266	75	-	57	6	26,633
Denford DS00 Mid	2093	1589	269	75	-	57	4	16,105
Elerton EOT Hip D	3125	1804	352	75	-	77	23	123,154
Elerton Mid DS01	2596	1806	361	75	-	77	2	9,679
Flat 1F	3325	1843	388	75	-	82	16	90,269
Flat GF	2405	1545	271	75	-	53	16	68,723
H403-G7 DS04 De	4384	1838	429	75	-	99	1	6,825
H417 ---7	5792	1898	482	75	-	135	4	32,989
H442-H7 DS00 De	4856	2143	492	75	-	124	8	68,093
H456-X7 DS07 De	5442	2198	481	75	-	137	22	180,310
H469 ---7	6085	2247	500	75	-	143	23	204,859
H486 ---7	5074	2107	436	75	-	113	15	115,366
Kerley EOT Hip DS	2601	1601	269	75	-	58	10	44,461
Maidstone EOT DS	3198	1803	352	75	-	77	31	168,284
Maidstone Mid DS0	2655	1805	361	75	-	77	2	9,794
Moresby Det DS07	3807	1833	354	75	-	81	12	72,828
Moresby EOT DS01	3329	1834	356	75	-	81	14	78,324
T322-E-7	4512	1976	434	75	-	111	10	69,971
Type 51 EOT	3364	1800	362	75	-	77	19	106,424
Type 51 MOT	2884	1802	373	75	-	77	4	20,539
Type 52 EOT	3481	1861	395	75	-	85	12	69,743
Type 52 MOT	2928	1863	407	75	-	85	6	31,634
Type 54 EOT	4136	1946	436	75	-	101	5	32,963
Type 54 MOT	3584	1947	446	75	-	101	1	6,052
Type 55 EOT	3842	1878	394	75	-	87	13	80,457
Data Set 1 Total Energy Demand (kWh/Annum)								1,870,690

Energy Demand Reduction Study
Drove Lane, Yapton

Client: Barratt Southern Counties								
Project: Drove Lane, Yapton								
Report: Energy Reduction from Fabric Improvements and On-Site Renewable Energy Generation								
House Type/ Plot Number	Space Heating Requirement	Hot Water Requirement	Lighting Requirement	Pumps and Fans Requirement	PV Contribution	SAP Floor Area	Number of Plots	Total Energy Demand ^{#1}
-	kWh/Annum	kWh/Annum	kWh/Annum	kWh/Annum	kWh/Annum	m ²	-	kWh/Annum
Data Set 2: Actual Case (With Renewables)								
2BF Det	3567	1622	297	75	-	60	1	5,561
2BF ET	3308	1623	297	75	-	60	1	5,303
Alverton CL Mid	2777	1624	299	75	-	60	1	4,775
Bewdley Det	4068	1893	375	75	-	90	7	44,877
Blyford Det	4068	1893	375	75	-	90	10	64,109
Denford DS00 EOT	2227	1588	286	75	-	57	6	24,933
Denford DS00 Mid	1741	1591	289	75	-	57	4	14,703
Ellerton EOT Hip D:	2854	1806	352	75	-	77	23	112,390
Ellerton Mid DS01	2013	1809	361	75	-	77	2	8,517
Flat 1F	3486	1843	398	75	-	82	18	92,824
Flat GF	2299	1548	271	75	-	53	16	67,038
H403--G7 DS04 De	3977	1939	429	75	-	99	1	6,419
H417 ---7	5463	1900	482	75	-	135	4	31,681
H442--H7 DS00 De	4549	2148	492	75	-	124	9	65,354
H456--X7 DS07 De	5014	2201	481	75	-	137	22	170,979
H469 ---7	5757	2249	500	75	-	143	23	197,371
H486 ---7	4721	2110	436	75	-	113	8	58,729
H488-7 Det PV	4710	2110	436	75	4337	113	7	20,955
Kenley EOT Hip DS	2116	1803	289	75	-	58	10	40,620
Maidstone EOT DS	2655	1805	352	75	-	77	31	151,516
Maidstone Mid DS6	1961	1809	361	75	-	77	2	8,413
Moresby Det PV	3448	1834	354	75	3132	81	12	30,935
Moresby EOT DS0:	2864	1836	356	75	-	81	14	71,844
T322-E-7	4019	1978	434	75	-	111	10	65,057
Type 51 EOT	2854	1803	362	75	-	77	19	98,658
Type 51 MOT	2314	1805	373	75	-	77	4	18,266
Type 52 EOT	3009	1862	395	75	-	85	12	64,099
Type 52 MOT	2314	1866	407	75	-	85	6	27,972
Type 54 EOT	3510	1947	436	75	-	101	5	29,844
Type 54 MOT	2792	1950	446	75	-	101	1	5,264
Type 55 EOT	3373	1879	394	75	-	87	13	74,383
Data Set 2 Total Energy Demand (kWh/Annum)								1,663,398
Reduction in Energy Demand								10.0%
Notes								
#1: Calculated by SAP2012 to include total energy demand for space heating, hot water, lighting, pumps and fans.								

Appendix C



Cavity Wall

Cavity widths from 90mm to 165mm

OUTER LEAF	INNER LEAF
102mm	100mm

If lintels are required to carry loads not indicated on the load tables, please contact IG's Technical Department.

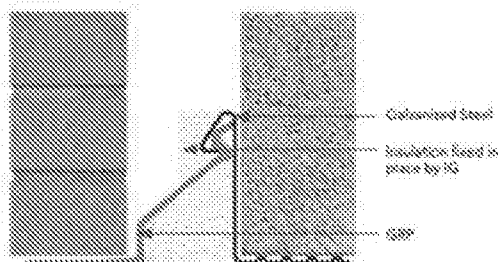
LINTEL HOTLINE
01633 486486

For Rack Enquiry Forms are also available for download.
www.iglintels.com/technical

IG Fasttrack CAD Database is accessible from iglintels.com

Hi-Therm Lintel

IG leads the way with the development of a completely unique lintel range to address the thermal requirements of new building regulations.



Psi 0.05 W/m·K

Building regulations require that lintels should be assessed for their effect on the thermal performance of a building. The thermal performance of a lintel is expressed in terms of Psi Values (Ψ) i.e. linear thermal transmittance.

Psi COMPARISON CHART

To help understand the immense thermal benefits of the Hi-Therm Lintel it must be compared to other lintel types.

Lintel Type Comparison	Ψ value
IG Hi-Therm Lintel	0.05 W/m·K
Typical IG Lintel	0.23 W/m·K
Non-plated Steel Lintel (default)	0.3 W/m·K
Plated Steel Lintel (default)	0.5 W/m·K



TECHNICAL
PERFORMANCE
TESTING

Testing of IG's Hi-Therm Lintel was carried out by the BRE Building Research Establishment using Pyralis's thermal analysis software THERMO which complies with BS EN ISO 10211-1. The modelling follows the requirements of the BRE conventions document BR497.

KEY BENEFITS

- Up to 5 times more thermally efficient than a steel cavity wall lintel, Hi-Therm outperforms other lintels.
- The significant reductions in thermal bridging due to the GRP component will assist in the building design process to achieve compliance with Part L and The Code for Sustainable Homes.
- The use of Hi-Therm will make a significant contribution to a buildings performance in respect of the Fabric Energy Efficiency Standards (FEES).
- Outperforms Stainless Steel on price and corrosion resistance.
- Hi-Therm has achieved the 1 hour fire resistance test as carried out by Exova Warringtonfire utilising the heating conditions of BS EN 1363-1:1999.

DESIGN FEATURES

- Patented GRP and Galvanised Steel hybrid design.
- Galvanised steel is used to support the heavier load on the inner leaf of the cavity wall.
- Profiled CFC free insulation ensures the continuity of insulation.

DAMP PROOFING

Not required on Hi-Therm lintels.

*Check severe exposure.

Appendix D

See following pages for SAP worksheets

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BAVT OVCD DS00 Alverton Rooflight Detached Part L2013 Masonry, 2016 Range , Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	2.71 (1a)	x	2.59 (2a)	=	7.02 (3a)
+1	57.47 (1b)	x	2.31 (2b)	=	132.76 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		60.18 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		139.77 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.21 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.47 (18)
Number of sides on which the dwelling is sheltered			0 (19)
Shelter factor		1 - [0.075 x (19)] =	1.00 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.47 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.59	0.58	0.57	0.51	0.50	0.44	0.44	0.43	0.47	0.50	0.52	0.55

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.68	0.67	0.66	0.63	0.63	0.60	0.60	0.59	0.61	0.63	0.64	0.65
------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.68	0.67	0.66	0.63	0.63	0.60	0.59	0.61	0.63	0.64	0.65	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			4.40	1.24	5.44		(27)
Roof window			2.92	1.59	4.65		(27a)
Ground floor			2.71	0.14	0.38		(28a)
Exposed floor			54.76	0.17	9.31		(28b)
External wall			7.91	0.27	2.14		(29a)
External wall			7.43	0.26	1.93		(29a)
External wall			68.86	0.25	17.22		(29a)
External wall			9.47	0.30	2.84		(29a)
Roof			53.66	0.11	5.90		(30)
Roof			0.00	0.16	0.00		(30)
Total area of external elements $\sum A$, m ²			214.09				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	51.77	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						109.65	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						22.54	(36)
Total fabric heat loss					(33) + (36) =	74.31	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
31.17	30.86	30.55	29.10	28.83	27.57	27.57	27.33	28.05	28.83	29.38	29.95	(38)

Heat transfer coefficient, W/K (37)m + (38)m											
105.48	105.16	104.86	103.41	103.13	101.87	101.87	101.64	102.36	103.13	103.68	104.26
Average = $\sum(39)1...12/12 =$										103.40	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)											
1.75	1.75	1.74	1.72	1.71	1.69	1.69	1.69	1.70	1.71	1.72	1.73
Average = $\sum(40)1...12/12 =$										1.72	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.99	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.38	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
89.52	86.27	83.01	79.76	76.50	73.25	73.25	76.50	79.76	83.01	86.27	89.52
$\sum(44)1...12 =$										976.61	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)											
132.76	116.11	119.82	104.46	100.23	86.49	80.15	91.97	93.07	108.46	118.40	128.57
$\sum(45)1...12 =$										1280.50	(45)

Distribution loss 0.15 x (45)m												
19.91	17.42	17.97	15.67	15.03	12.97	12.02	13.80	13.96	16.27	17.76	19.29	(45)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.04	12.67	14.00	13.51	13.94	13.46	13.90	13.93	13.49	13.97	13.56	14.03	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	
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$$\Sigma(64)1...12 = 1444.99 \quad (64)$$

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

47.65	41.77	43.34	38.11	36.81	32.13	30.12	34.06	34.32	39.56	42.76	46.26	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

42.03	37.33	30.36	22.98	17.18	14.50	15.67	20.37	27.34	34.72	40.52	43.20	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

258.81	261.49	254.72	240.32	222.13	205.04	193.62	190.93	197.70	212.11	230.29	247.39	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	(71)
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Water heating gains (Table 5)

64.05	62.16	58.25	52.93	49.48	44.62	40.49	45.78	47.66	53.17	59.38	62.17	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

453.53	449.63	431.98	404.88	377.43	352.80	338.42	345.73	361.35	388.64	418.84	441.40	(73)
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6. Solar gains

Access factor
Table 6d

Area
m²

Solar flux
W/m²

g
specific data
or Table 6b

FF
specific data
or Table 6c

Gains
W

South 0.77 x 4.40 x 46.75 x 0.9 x 0.71 x 0.70 = 70.85 (78)

North 1.00 x 2.92 x 16.18 x 0.9 x 0.72 x 0.70 = 21.43 (74)

Solar gains in watts $\Sigma(74)m...(82)m$

92.28	156.61	221.59	301.21	372.12	387.50	365.87	308.36	247.46	174.21	110.21	79.29	(83)
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Total gains - internal and solar (73)m + (83)m

545.80	606.24	653.56	706.08	749.56	740.30	704.29	654.08	608.81	562.84	529.05	520.69	(84)
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7. Mean internal temperature (heating season)

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

21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.94	0.93	0.90	0.85	0.77	0.64	0.52	0.57	0.74	0.87	0.93	0.95	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

18.08	18.35	18.81	19.46	20.09	20.58	20.81	20.77	20.39	19.61	18.75	18.04	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.50	19.51	19.51	19.53	19.53	19.55	19.55	19.55	19.54	19.53	19.52	19.52	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.93	0.91	0.88	0.82	0.71	0.55	0.39	0.43	0.66	0.83	0.91	0.94	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

15.76	16.14	16.81	17.73	18.58	19.21	19.45	19.42	18.99	17.96	16.74	15.70	(90)
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Living area fraction

Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

16.53	16.87	17.47	18.30	19.08	19.66	19.90	19.86	19.45	18.51	17.40	16.47	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

16.38	16.72	17.32	18.15	18.93	19.51	19.75	19.71	19.30	18.36	17.25	16.32	(93)
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6. Space heating requirement

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

Utilisation factor for gains, ηm

0.90	0.88	0.84	0.78	0.68	0.55	0.41	0.45	0.64	0.80	0.87	0.91	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

492.02	532.90	551.89	552.19	512.80	404.37	287.03	293.80	389.56	448.01	462.84	473.24	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1273.66	1243.02	1134.51	956.63	745.46	500.19	320.71	336.81	532.55	800.27	1052.76	1263.98	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

581.54	477.20	433.47	291.19	173.10	0.00	0.00	0.00	0.00	262.08	424.74	588.32	
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Σ(98)1...5, 10...12 = 3231.64 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 53.70 (99)

9a. Energy requirement - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (203)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.60 (206)

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

Space heating fuel (main system 1), kWh/month

641.88	526.71	478.44	321.41	191.06	0.00	0.00	0.00	0.00	289.27	468.81	649.35	
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Σ(211)1...5, 10...12 = 3566.93 (211)

Water heating

Efficiency of water heater

89.94	89.90	89.82	89.65	89.30	87.40	87.40	87.40	87.40	89.56	89.82	89.96	(217)
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Water heating fuel, kWh/month

163.23	143.25	148.97	131.59	127.85	114.37	107.60	121.16	121.92	136.71	146.91	158.52	
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Σ(219a)1...12 = 1622.09 (219)

Annual totals

Space heating fuel - main system 1			3566.93	
Water heating fuel			1622.09	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			296.91	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =		5560.93	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3566.93	x	3.48	x 0.01 =	124.13	(240)
Water heating	1622.09	x	3.48	x 0.01 =	56.45	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	296.91	x	13.19	x 0.01 =	39.16	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		349.63	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.40	(257)
SAP value	80.52	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3566.93	x	0.216	=	770.46	(261)
Water heating	1622.09	x	0.216	=	350.37	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1120.83	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	296.91	x	0.519	=	154.09	(268)
Total CO ₂ , kg/year				(265)...(271) =	1313.85	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	21.83	(273)
EI value					83.26	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3566.93	x	1.22	=	4351.66	(261)
Water heating	1622.09	x	1.22	=	1978.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6330.61	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	296.91	x	3.07	=	911.50	(268)
Primary energy kWh/year					7472.36	(272)

DRAFT

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BAVT 0VHS DS00 Alverton Hipped Roof EOT Part L2013 Masonry, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	2.71 (1a)	x	2.59 (2a)	=	7.02 (3a)
+1	57.47 (1b)	x	2.31 (2b)	=	132.76 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				60.18 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				139.77 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.21 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.47 (18)
Number of sides on which the dwelling is sheltered			0 (19)
Shelter factor	1 - [0.075 x (19)] =		1.00 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.47 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.59	0.58	0.57	0.51	0.50	0.44	0.44	0.43	0.47	0.50	0.52	0.55

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.68	0.67	0.66	0.63	0.63	0.60	0.60	0.59	0.61	0.63	0.64	0.65
------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.68	0.67	0.66	0.63	0.63	0.60	0.60	0.59	0.61	0.63	0.64	0.65	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			4.40	1.24	5.44		(27)
Roof window			2.92	1.59	4.65		(27a)
Ground floor			2.71	0.14	0.38		(28a)
Exposed floor			54.76	0.17	9.31		(28b)
External wall			7.91	0.27	2.14		(29a)
External wall			7.43	0.26	1.93		(29a)
External wall			56.53	0.25	14.13		(29a)
Party wall			12.33	0.00	0.00		(32)
External wall			9.47	0.30	2.84		(29a)
Roof			53.66	0.11	5.90		(30)
Roof			0.00	0.16	0.00		(30)
Total area of external elements ΣA, m ²			201.76				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	48.69	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						109.65	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						19.64	(36)
Total fabric heat loss					(33) + (36) =	68.32	(37)

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

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

31.17	30.86	30.55	29.10	28.83	27.57	27.57	27.33	28.05	28.83	29.38	29.95	(38)
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Heat transfer coefficient, W/K (37)m + (38)m

99.50	99.18	98.87	97.42	97.15	95.89	95.89	95.65	96.38	97.15	97.70	98.27	
Average = Σ(39)1...12/12 =											97.42	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.65	1.65	1.64	1.62	1.61	1.59	1.59	1.59	1.60	1.61	1.62	1.63	
Average = Σ(40)1...12/12 =											1.62	(40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N

1.99 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

81.38 (43)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

89.52	86.27	83.01	79.76	76.50	73.25	73.25	76.50	79.76	83.01	86.27	89.52	
Σ(44)1...12 =											976.61	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

132.76	116.11	119.82	104.46	100.23	86.49	80.15	91.97	93.07	108.46	118.40	128.57	
Σ(45)1...12 =											1280.50	(45)

Distribution loss 0.15 x (45)m

19.91	17.42	17.97	15.67	15.03	12.97	12.02	13.80	13.96	16.27	17.76	19.29	(46)
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Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.04	12.67	14.00	13.51	13.94	13.46	13.90	13.93	13.49	13.97	13.56	14.03	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	
$\Sigma(64)1...12 =$											1444.99	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

47.65	41.77	43.34	38.11	36.81	32.13	30.12	34.06	34.32	39.56	42.76	46.26	(65)
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5. Internal gains

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

119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

42.03	37.33	30.36	22.98	17.18	14.50	15.67	20.37	27.34	34.72	40.52	43.20	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

258.81	261.49	254.72	240.32	222.13	205.04	193.62	190.93	197.70	212.11	230.29	247.39	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	(71)
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Water heating gains (Table 5)

64.05	62.16	58.25	52.93	49.48	44.62	40.49	45.78	47.66	53.17	59.38	62.17	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

453.53	449.63	431.98	404.88	377.43	352.80	338.42	345.73	361.35	388.64	418.84	441.40	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
South	0.77	x 4.40	x 46.75	x 0.9 x 0.71	x 0.70	= 70.85	(78)
North	1.00	x 2.92	x 16.18	x 0.9 x 0.72	x 0.70	= 21.43	(74)

Solar gains in watts $\Sigma(74)m...(82)m$

92.28	156.61	221.59	301.21	372.12	387.50	365.87	308.36	247.46	174.21	110.21	79.29	(83)
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Total gains - internal and solar (73)m + (83)m

545.80	606.24	653.56	706.08	749.56	740.30	704.29	654.08	608.81	562.84	529.05	520.69	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)											21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains for living area n1,m (see Table 9a)

0.94	0.93	0.90	0.84	0.75	0.63	0.51	0.55	0.72	0.86	0.92	0.95	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

18.24	18.50	18.95	19.58	20.18	20.63	20.84	20.80	20.45	19.72	18.89	18.20	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.57	19.58	19.58	19.60	19.60	19.62	19.62	19.62	19.61	19.60	19.60	19.59	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.93	0.91	0.88	0.81	0.70	0.54	0.38	0.42	0.65	0.83	0.91	0.94	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

16.01	16.39	17.04	17.93	18.74	19.32	19.53	19.51	19.12	18.14	16.96	15.96	(90)
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Living area fraction

Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

16.75	17.09	17.67	18.48	19.21	19.75	19.96	19.93	19.56	18.66	17.60	16.70	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

16.60	16.94	17.52	18.33	19.06	19.60	19.81	19.78	19.41	18.51	17.45	16.55	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.90	0.88	0.84	0.78	0.68	0.54	0.40	0.44	0.63	0.79	0.87	0.91	(94)
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Useful gains, ηmGm, W (94)m x (84)m

491.76	532.22	550.46	549.14	507.27	396.71	279.89	287.12	384.62	445.96	462.20	473.08	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1223.41	1193.97	1089.84	918.48	715.47	479.70	308.25	323.72	511.57	768.90	1011.02	1213.42	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

544.34	444.69	401.30	265.93	154.90	0.00	0.00	0.00	0.00	240.27	395.15	550.81	(98)
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Σ(98)1...5, 10...12 = 2997.39 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 49.81 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (203)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.60 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

600.82	490.83	442.94	293.52	170.97	0.00	0.00	0.00	0.00	265.20	436.15	607.96	(211)
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Σ(211)1...5, 10...12 = 3308.38 (211)

Water heating

Efficiency of water heater

89.90	89.86	89.78	89.59	89.21	87.40	87.40	87.40	87.40	89.49	89.78	89.92	(217)
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Water heating fuel, kWh/month

163.29	143.31	149.05	131.68	127.98	114.37	107.60	121.16	121.92	136.81	146.98	158.58	
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$$\Sigma(219a)1...12 = 1622.74 \quad (219)$$

Annual totals

Space heating fuel - main system 1		3308.38	
Water heating fuel		1622.74	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		296.91	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5303.02	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3308.38	x	3.48	x 0.01 =	115.13	(240)
Water heating	1622.74	x	3.48	x 0.01 =	56.47	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	296.91	x	13.19	x 0.01 =	39.16	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		340.66	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.36	(257)
SAP value	81.02	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3308.38	x	0.216	=	714.61	(261)
Water heating	1622.74	x	0.216	=	350.51	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1065.12	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	296.91	x	0.519	=	154.09	(268)
Total CO ₂ , kg/year			(265)...(271) =		1258.14	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		20.91	(273)
EI value					83.97	
EI rating (section 14)					84	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3308.38	x	1.22	=	4036.22	(261)
Water heating	1622.74	x	1.22	=	1979.74	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6015.96	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	296.91	x	3.07	=	911.50	(268)

Primary energy kWh/year

7157.72	(272)
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Dwelling primary energy rate kWh/m2/year

118.94	(273)
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This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	Alverton Classic Mid Terr 2016 Range - BAVT 00CI, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	2.71 (1a)	x	2.59 (2a)	=	7.02 (3a)
+1	57.47 (1b)	x	2.28 (2b)	=	131.03 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		60.18 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		138.05 (5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	{6a}
Number of open flues	0	x 20 =	0	{6b}
Number of intermittent fans	3	x 10 =	30	{7a}
Number of passive vents	0	x 10 =	0	{7b}
Number of flueless gas fires	0	x 40 =	0	{7c}
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.22 {8}
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01	{17}
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.47	{18}
Number of sides on which the dwelling is sheltered			2	{19}
Shelter factor	1 - [0.075 x (19)] =		0.85	{20}
Infiltration rate incorporating shelter factor	(18) x (20) =		0.40	{21}
Infiltration rate modified for monthly wind speed:				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.51	0.50	0.49	0.44	0.43	0.38	0.38	0.37	0.40	0.43	0.45	0.47

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			7.66	1.24	9.47		(27)
Ground floor			2.71	0.14	0.38		(28a)
Exposed floor			54.76	0.17	9.31		(28b)
External wall			7.91	0.27	2.14		(29a)
External wall			48.38	0.25	12.10		(29a)
External wall			2.44	0.30	0.73		(29a)
Party wall			24.65	0.00	0.00		(32)
Roof			57.47	0.11	6.32		(30)
Total area of external elements ΣA, m ²			183.30				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	42.41	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						109.85	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						14.66	(36)
Total fabric heat loss						(33) + (36) =	57.07 (37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
28.63	28.41	28.18	27.14	26.94	26.03	26.03	25.86	26.38	26.94	27.34	27.75	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
85.70	85.48	85.25	84.21	84.01	83.10	83.10	82.93	83.45	84.01	84.41	84.82	
Average = $\sum(39)1...12/12 =$											84.21	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.42	1.42	1.42	1.40	1.40	1.38	1.38	1.38	1.39	1.40	1.40	1.41	
Average = $\sum(40)1...12/12 =$											1.40	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.99	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.38	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
89.52	86.27	83.01	79.76	76.50	73.25	73.25	76.50	79.76	83.01	86.27	89.52	
										Σ(44)1...12 =	976.61	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
132.76	116.11	119.82	104.46	100.23	86.49	80.15	91.97	93.07	108.46	118.40	128.57	
Σ(45)1...12 =											1280.50	(45)

Distribution loss 0.15 x (45)m												
19.91	17.42	17.97	15.67	15.03	12.97	12.02	13.80	13.96	16.27	17.76	19.29	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.04	12.67	14.00	13.51	13.94	13.46	13.90	13.93	13.49	13.97	13.56	14.03	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) $(62)m + (63)m$

146.80	128.78	133.81	117.97	114.17	99.96	94.05	105.90	106.56	122.44	131.95	142.60	
$\Sigma(64)1...12 =$											1444.99	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

47.65	41.77	43.34	38.11	36.81	32.13	30.12	34.06	34.32	39.56	42.76	46.26	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	119.20	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

42.34	37.61	30.58	23.15	17.31	14.61	15.79	20.52	27.55	34.97	40.82	43.52	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

258.81	261.49	254.72	240.32	222.13	205.04	193.62	190.93	197.70	212.11	230.29	247.39	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	48.91	(69)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	-79.47	(71)
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Water heating gains (Table 5)

64.05	62.16	58.25	52.93	49.48	44.62	40.49	45.78	47.66	53.17	59.38	62.17	(72)
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Total internal gains $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$

456.84	452.90	435.20	408.04	380.56	355.91	341.54	348.88	364.55	391.89	422.14	444.72	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
South	0.77	x 4.40	x 46.75	x 0.9 x 0.71	x 0.70	= 70.85	(78)
North	0.77	x 3.26	x 10.63	x 0.9 x 0.71	x 0.70	= 11.94	(74)

Solar gains in watts $\Sigma(74)m...(82)m$

82.79	138.85	186.58	229.33	257.97	257.34	247.53	225.49	201.02	152.31	98.71	71.17	(83)
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Total gains - internal and solar $(73)m + (83)m$

539.63	591.75	621.78	637.38	638.53	613.25	589.07	574.36	565.57	544.21	520.85	515.90	(84)
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7. Mean internal temperature (heating season)

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

21.00	(85)
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.94	0.92	0.90	0.85	0.78	0.66	0.53	0.56	0.72	0.85	0.92	0.95	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

18.62	18.86	19.25	19.77	20.26	20.67	20.86	20.84	20.56	19.94	19.20	18.58	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.74	19.75	19.75	19.76	19.77	19.78	19.78	19.78	19.77	19.77	19.76	19.76	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.91	0.88	0.82	0.73	0.58	0.41	0.44	0.65	0.82	0.90	0.94	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

16.65	16.99	17.55	18.29	18.97	19.49	19.70	19.68	19.36	18.54	17.49	16.59	(90)
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Living area fraction

Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.30	17.61	18.11	18.78	19.39	19.88	20.08	20.06	19.76	19.00	18.06	17.25	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.15	17.46	17.96	18.63	19.24	19.73	19.93	19.91	19.61	18.85	17.91	17.10	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.90	0.88	0.85	0.79	0.71	0.57	0.43	0.46	0.63	0.79	0.87	0.91	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

486.33	520.10	526.43	505.50	452.15	352.53	252.40	261.78	358.94	430.33	454.69	468.92	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1101.32	1073.55	977.17	818.98	633.82	426.22	276.85	291.29	459.55	693.16	912.28	1093.93	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

457.55	371.92	335.35	225.70	135.16	0.00	0.00	0.00	0.00	195.54	329.46	465.01	
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Σ(98)1...5, 10...12 = 2515.70 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 41.80 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (203)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.60 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

505.02	410.51	370.14	249.12	149.18	0.00	0.00	0.00	0.00	215.83	363.65	513.26	
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Σ(211)1...5, 10...12 = 2776.71 (211)

Water heating

Efficiency of water heater

89.80	89.75	89.66	89.48	89.11	87.40	87.40	87.40	87.40	89.34	89.66	89.83	(217)
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Water heating fuel, kWh/month

163.47	143.48	149.24	131.85	128.13	114.37	107.60	121.16	121.92	137.04	147.17	158.75	
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Σ(219a)1...12 = 1624.20 (219)

Annual totals

Space heating fuel - main system 1

2776.71

Water heating fuel		1624.20	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		299.09	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4775.00	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2776.71	x	3.48	x 0.01 =	96.63	(240)
Water heating	1624.20	x	3.48	x 0.01 =	56.52	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	299.09	x	13.19	x 0.01 =	39.45	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		322.49	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.29	(257)
SAP value	82.04	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2776.71	x	0.216	=	599.77	(261)
Water heating	1624.20	x	0.216	=	350.83	(264)
Space and water heating			(261) + (262) + (263) + (264) =		950.60	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	299.09	x	0.519	=	155.23	(268)
Total CO ₂ , kg/year			(265)...(271) =		1144.75	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		19.02	(273)
EI value					85.42	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2776.71	x	1.22	=	3387.59	(261)
Water heating	1624.20	x	1.22	=	1981.52	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5369.11	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	299.09	x	3.07	=	918.22	(268)
Primary energy kWh/year					6517.58	(272)
Dwelling primary energy rate kWh/m ² /year					108.30	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BAVR 00CD Detached Part L2013 Masonry, Hipped Roof, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	41.19 (1a)	x	2.31 (2a)	=	95.15 (3a)
+1	48.49 (1b)	x	2.56 (2b)	=	124.13 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		89.68 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		219.28 (5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
Air changes per hour				
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40		÷ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area				5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)				0.43 (18)
Number of sides on which the dwelling is sheltered				0 (19)
Shelter factor	1 - [0.075 x (19)] =		1.00	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.43	(21)
Infiltration rate modified for monthly wind speed:				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.40	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Window			19.34	1.24	23.90		(27)
Door			1.97	1.00	1.97		(26)
Ground floor			41.19	0.14	5.77		(28a)
Exposed floor			14.06	0.19	2.67		(28b)
External wall			107.89	0.27	29.13		(29a)
External wall			17.48	0.26	4.54		(29a)
External wall			2.53	0.20	0.51		(29a)
Roof			55.23	0.11	6.08		(30)
Total area of external elements ΣA, m ²			259.69				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	74.56	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						160.94	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						12.48	(36)
Total fabric heat loss					(33) + (36) =	87.04	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
47.21	46.78	46.36	44.39	44.02	42.30	42.30	41.98	42.96	44.02	44.76	45.54	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
134.25	133.82	133.40	131.43	131.06	129.34	129.34	129.03	130.01	131.06	131.81	132.59	
Average = $\sum(39)1...12/12 =$											131.43	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.50	1.49	1.49	1.47	1.46	1.44	1.44	1.44	1.45	1.46	1.47	1.48	
Average = $\sum(40)1...12/12 =$											1.47	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.62	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	96.46	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
106.10	102.24	98.39	94.53	90.67	86.81	86.81	90.67	94.53	98.39	102.24	106.10	
										Σ(44)1...12 =	1157.47	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
157.35	137.62	142.01	123.81	118.79	102.51	94.99	109.00	110.31	128.55	140.32	152.38	
Σ(45)1...12 =											1517.63	(45)

Distribution loss 0.15 x (45)m												
23.60	20.64	21.30	18.57	17.82	15.38	14.25	16.35	16.55	19.28	21.05	22.86	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

14.13	12.76	14.09	13.59	14.02	13.53	13.95	13.99	13.56	14.06	13.65	14.12	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

171.48	150.37	156.10	137.40	132.81	116.04	108.95	123.00	123.87	142.61	153.97	166.50	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

171.48	150.37	156.10	137.40	132.81	116.04	108.95	123.00	123.87	142.61	153.97	166.50	
$\Sigma(64)1...12 =$											1683.09	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

55.85	48.95	50.74	44.56	43.00	37.47	35.07	39.74	40.07	46.26	50.07	54.20	(65)
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5. Internal gains

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

157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

53.15	47.21	38.39	29.07	21.73	18.34	19.82	25.76	34.58	43.91	51.25	54.63	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

355.95	359.65	350.34	330.52	305.51	282.00	266.29	262.60	271.91	291.72	316.74	340.25	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	(71)
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Water heating gains (Table 5)

75.07	72.84	68.20	61.89	57.80	52.04	47.14	53.42	55.65	62.17	69.54	72.85	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

592.95	588.47	565.71	530.26	493.81	461.16	442.03	450.56	470.91	506.58	546.30	576.50	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	1.00	x	5.49	x	19.64	x 0.9 x	0.71	x	0.70	=	48.23	(76)
North	1.00	x	1.98	x	10.63	x 0.9 x	0.71	x	0.70	=	9.42	(74)
South	1.00	x	1.69	x	46.75	x 0.9 x	0.71	x	0.70	=	35.34	(78)
West	1.00	x	10.18	x	19.64	x 0.9 x	0.71	x	0.70	=	89.43	(80)

Solar gains in watts $\Sigma(74)m...(82)m$

182.42	345.17	547.80	779.26	945.70	965.86	920.33	795.37	629.59	403.40	225.16	151.60	(83)
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Total gains - internal and solar (73)m + (83)m

775.37	933.64	1113.51	1309.52	1439.51	1427.02	1362.36	1245.92	1100.50	909.98	771.46	728.09	(84)
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7. Mean internal temperature (heating season)

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

												21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.97	0.95	0.91	0.82	0.69	0.53	0.40	0.45	0.67	0.88	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.01	19.30	19.76	20.30	20.69	20.90	20.97	20.95	20.79	20.24	19.52	18.96	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.69	19.69	19.70	19.71	19.72	19.73	19.73	19.73	19.73	19.72	19.71	19.70	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.89	0.78	0.62	0.44	0.29	0.34	0.59	0.84	0.95	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.11	17.53	18.18	18.93	19.42	19.66	19.72	19.71	19.55	18.87	17.87	17.05	(90)
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Living area fraction

Living area ÷ (4) = 0.18 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.44	17.84	18.46	19.17	19.64	19.88	19.94	19.93	19.77	19.11	18.16	17.38	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.29	17.69	18.31	19.02	19.49	19.73	19.79	19.78	19.62	18.96	18.01	17.23	(93)
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8. Space heating requirement

Utilisation factor for gains, ηm

0.95	0.92	0.86	0.76	0.61	0.44	0.30	0.34	0.58	0.82	0.92	0.96	(94)
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Useful gains, ηmGm, W (94)m x (84)m

735.69	857.99	960.20	992.54	881.85	627.99	404.97	424.87	635.62	743.89	712.39	696.02	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1744.02	1712.11	1575.67	1330.20	1021.18	663.48	412.39	436.33	717.75	1096.10	1438.05	1728.16	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

750.20	573.97	457.91	243.11	103.66	0.00	0.00	0.00	0.00	262.05	522.48	767.91	(98)
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Σ(98)1...5, 10...12 = 3681.30 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 41.05 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

828.95	634.22	505.98	268.63	114.55	0.00	0.00	0.00	0.00	289.56	577.32	848.52	(211)
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Σ(211)1...5, 10...12 = 4067.73 (211)

Water heating

Efficiency of water heater

89.89	89.82	89.66	89.32	88.67	87.30	87.30	87.30	87.30	89.35	89.75	89.91	(217)
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Water heating fuel, kWh/month

190.77	167.42	174.09	153.83	149.77	132.92	124.79	140.89	141.89	159.62	171.55	185.18	(219)
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Σ(219a)1...12 = 1892.73 (219)

Annual totals

Space heating fuel - main system 1		4067.73	
Water heating fuel		1892.73	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		375.48	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6410.95	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4067.73	x	3.48	x 0.01 =	141.56	(240)
Water heating	1892.73	x	3.48	x 0.01 =	65.87	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	375.48	x	13.19	x 0.01 =	49.53	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	386.84	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.17	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4067.73	x	0.216	=	878.63	(261)
Water heating	1892.73	x	0.216	=	408.83	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1287.46	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	375.48	x	0.519	=	194.88	(268)
Total CO ₂ , kg/year				(265)...(271) =	1521.26	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	16.96	(273)
EI value					84.86	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4067.73	x	1.22	=	4962.63	(261)
Water heating	1892.73	x	1.22	=	2309.13	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7271.77	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	375.48	x	3.07	=	1152.73	(268)
Primary energy kWh/year					8654.75	(272)
Dwelling primary energy rate kWh/m ² /year					96.51	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BAVR 00CD Detached Part L2013 Masonry, Hipped Roof, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	41.19 (1a)	x	2.31 (2a)	=	95.15 (3a)
+1	48.49 (1b)	x	2.56 (2b)	=	124.13 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		89.68 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		219.28 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.43 (18)
Number of sides on which the dwelling is sheltered			0 (19)
Shelter factor		1 - [0.075 x (19)] =	1.00 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.43 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.55	0.54	0.53	0.48	0.47	0.41	0.41	0.40	0.43	0.47	0.49	0.51

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Window			19.34	x 1.24	= 23.90		(27)
Door			1.97	x 1.00	= 1.97		(26)
Ground floor			41.19	x 0.14	= 5.77		(28a)
Exposed floor			14.06	x 0.19	= 2.67		(28b)
External wall			107.89	x 0.27	= 29.13		(29a)
External wall			17.48	x 0.26	= 4.54		(29a)
External wall			2.53	x 0.20	= 0.51		(29a)
Roof			55.23	x 0.11	= 6.08		(30)
Total area of external elements ΣA, m ²			259.69				(31)
Fabric heat loss, W/K = Σ(A x U)						(26)...(30) + (32) =	74.56 (33)
Heat capacity Cm = Σ(A x κ)						(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m ² K							160.94 (35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							12.48 (36)
Total fabric heat loss						(33) + (36) =	87.04 (37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
47.21	46.78	46.36	44.39	44.02	42.30	42.30	41.98	42.96	44.02	44.76	45.54	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
134.25	133.82	133.40	131.43	131.06	129.34	129.34	129.03	130.01	131.06	131.81	132.59	
Average = $\sum(39)1...12/12 =$											131.43	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)												
1.50	1.49	1.49	1.47	1.46	1.44	1.44	1.44	1.45	1.46	1.47	1.48	
Average = $\sum(40)1...12/12 =$											1.47	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.62	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	96.46	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
106.10	102.24	98.39	94.53	90.67	86.81	86.81	90.67	94.53	98.39	102.24	106.10
Σ(44)1...12 =										1157.47	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
157.35	137.62	142.01	123.81	118.79	102.51	94.99	109.00	110.31	128.55	140.32	152.38	
Σ(45)1...12 =											1517.63	(45)

Distribution loss 0.15 x (45)m

23.60	20.64	21.30	18.57	17.82	15.38	14.25	16.35	16.55	19.28	21.05	22.86	(46)
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Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

14.13	12.76	14.09	13.59	14.02	13.53	13.95	13.99	13.56	14.06	13.65	14.12	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

171.48	150.37	156.10	137.40	132.81	116.04	108.95	123.00	123.87	142.61	153.97	166.50	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

171.48	150.37	156.10	137.40	132.81	116.04	108.95	123.00	123.87	142.61	153.97	166.50	
$\Sigma(64)1...12 =$											1683.09	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

55.85	48.95	50.74	44.56	43.00	37.47	35.07	39.74	40.07	46.26	50.07	54.20	(65)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	157.28	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

53.15	47.21	38.39	29.07	21.73	18.34	19.82	25.76	34.58	43.91	51.25	54.63	(67)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

355.95	359.65	350.34	330.52	305.51	282.00	266.29	262.60	271.91	291.72	316.74	340.25	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	53.35	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	-104.85	(71)
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Water heating gains (Table 5)

75.07	72.84	68.20	61.89	57.80	52.04	47.14	53.42	55.65	62.17	69.54	72.85	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

592.95	588.47	565.71	530.26	493.81	461.16	442.03	450.56	470.91	506.58	546.30	576.50	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
East	1.00	x 5.49	x 19.64	x 0.9 x 0.71	x 0.70	= 48.23	(76)
North	1.00	x 1.98	x 10.63	x 0.9 x 0.71	x 0.70	= 9.42	(74)
South	1.00	x 1.69	x 46.75	x 0.9 x 0.71	x 0.70	= 35.34	(78)
West	1.00	x 10.18	x 19.64	x 0.9 x 0.71	x 0.70	= 89.43	(80)

Solar gains in watts $\Sigma(74)m...(82)m$

182.42	345.17	547.80	779.26	945.70	965.86	920.33	795.37	629.59	403.40	225.16	151.60	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Total gains - internal and solar (73)m + (83)m

775.37	933.64	1113.51	1309.52	1439.51	1427.02	1362.36	1245.92	1100.50	909.98	771.46	728.09	(84)
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7. Mean internal temperature (heating season)

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

												21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.97	0.95	0.91	0.82	0.69	0.53	0.40	0.45	0.67	0.88	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.01	19.30	19.76	20.30	20.69	20.90	20.97	20.95	20.79	20.24	19.52	18.96	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.69	19.69	19.70	19.71	19.72	19.73	19.73	19.73	19.73	19.72	19.71	19.70	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.89	0.78	0.62	0.44	0.29	0.34	0.59	0.84	0.95	0.97	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.11	17.53	18.18	18.93	19.42	19.66	19.72	19.71	19.55	18.87	17.87	17.05	(90)
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Living area fraction

Living area ÷ (4) = 0.18 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.44	17.84	18.46	19.17	19.64	19.88	19.94	19.93	19.77	19.11	18.16	17.38	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.29	17.69	18.31	19.02	19.49	19.73	19.79	19.78	19.62	18.96	18.01	17.23	(93)
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8. Space heating requirement

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

Utilisation factor for gains, ηm

0.95	0.92	0.86	0.76	0.61	0.44	0.30	0.34	0.58	0.82	0.92	0.96	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

735.69	857.99	960.20	992.54	881.85	627.99	404.97	424.87	635.62	743.89	712.39	696.02	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1744.02	1712.11	1575.67	1330.20	1021.18	663.48	412.39	436.33	717.75	1096.10	1438.05	1728.16	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

750.20	573.97	457.91	243.11	103.66	0.00	0.00	0.00	0.00	262.05	522.48	767.91	
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Σ(98)1...5, 10...12 = 3681.30 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 41.05 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

828.95	634.22	505.98	268.63	114.55	0.00	0.00	0.00	0.00	289.56	577.32	848.52	
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Σ(211)1...5, 10...12 = 4067.73 (211)

Water heating

Efficiency of water heater

89.89	89.82	89.66	89.32	88.67	87.30	87.30	87.30	87.30	89.35	89.75	89.91	(217)
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Water heating fuel, kWh/month

190.77	167.42	174.09	153.83	149.77	132.92	124.79	140.89	141.89	159.62	171.55	185.18	
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Σ(219a)1...12 = 1892.73 (219)

Annual totals

Space heating fuel - main system 1		4067.73	
Water heating fuel		1892.73	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		375.48	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6410.95	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4067.73	x	3.48	x 0.01 =	141.56	(240)
Water heating	1892.73	x	3.48	x 0.01 =	65.87	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	375.48	x	13.19	x 0.01 =	49.53	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	386.84	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.17	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4067.73	x	0.216	=	878.63	(261)
Water heating	1892.73	x	0.216	=	408.83	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1287.46	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	375.48	x	0.519	=	194.88	(268)
Total CO ₂ , kg/year				(265)...(271) =	1521.26	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	16.96	(273)
EI value					84.86	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4067.73	x	1.22	=	4962.63	(261)
Water heating	1892.73	x	1.22	=	2309.13	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7271.77	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	375.48	x	3.07	=	1152.73	(268)
Primary energy kWh/year					8654.75	(272)
Dwelling primary energy rate kWh/m ² /year					96.51	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BDNF 00CE Denford DS00 Hipped EOT Part L2013 Masonry, Classic Range, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	28.42 (1a)	x	2.31 (2a)	=	65.65 (3a)
+1	28.42 (1b)	x	2.56 (2b)	=	72.76 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		56.84 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		138.41 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	2	x 10 =	20 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.14 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] =	0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.31 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

	0.39	0.38	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.34	0.36
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft

	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.55	0.55	0.56	0.56	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Window			10.10	1.24	12.48		(27)
Door			1.97	1.00	1.97		(26)
Ground floor			28.42	0.14	3.98		(28a)
External wall			61.44	0.27	16.59		(29a)
Party wall			35.11	0.00	0.00		(32)
Roof			28.42	0.11	3.13		(30)
Total area of external elements ΣA, m ²			130.35				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	38.14	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						177.21	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						7.48	(36)
Total fabric heat loss					(33) + (36) =	45.63	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
26.32	26.18	26.05	25.43	25.31	24.77	24.77	24.67	24.98	25.31	25.55	25.79	(38)

Heat transfer coefficient, W/K (37)m + (38)m											
71.94	71.81	71.68	71.05	70.94	70.40	70.40	70.30	70.60	70.94	71.17	71.42
Average = Σ(39)1...12/12 =										71.05	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)											
1.27	1.26	1.26	1.25	1.25	1.24	1.24	1.24	1.24	1.25	1.25	1.26
Average = Σ(40)1...12/12 =										1.25	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.89	(42)									
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$	79.11	(43)									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
87.02	83.86	80.69	77.53	74.37	71.20	71.20	74.37	77.53	80.69	83.86	87.02
Σ(44)1...12 =										949.34	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)											
129.05	112.87	116.47	101.54	97.43	84.08	77.91	89.40	90.47	105.43	115.09	124.98
Σ(45)1...12 =										1244.74	(45)

Distribution loss 0.15 x (45)m												
19.36	16.93	17.47	15.23	14.61	12.61	11.69	13.41	13.57	15.82	17.26	18.75	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.03	12.65	13.98	13.50	13.93	13.46	13.89	13.92	13.48	13.96	13.54	14.02	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

143.08	125.52	130.45	115.05	111.36	97.53	91.80	103.32	103.95	119.40	128.63	139.00	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

143.08	125.52	130.45	115.05	111.36	97.53	91.80	103.32	103.95	119.40	128.63	139.00	
$\Sigma(64)1...12 =$											1409.10	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

46.42	40.69	42.22	37.14	35.88	31.32	29.38	33.21	33.45	38.55	41.65	45.06	(65)
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5. Internal gains

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

113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

37.62	33.41	27.17	20.57	15.38	12.98	14.03	18.23	24.47	31.08	36.27	38.66	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

246.14	248.69	242.26	228.55	211.26	195.00	184.14	181.59	188.02	201.73	219.02	235.28	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	(71)
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Water heating gains (Table 5)

62.39	60.55	56.75	51.58	48.22	43.50	39.49	44.63	46.46	51.81	57.85	60.57	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

435.20	431.72	415.24	389.77	363.92	340.54	326.71	333.51	348.02	373.67	402.20	423.57	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
SouthWest	0.77	x 3.30	x 36.79	x 0.9	x 0.71	x 0.70	= 41.82 (79)
NorthEast	0.77	x 6.14	x 11.28	x 0.9	x 0.71	x 0.70	= 23.86 (75)
NorthWest	0.77	x 0.66	x 11.28	x 0.9	x 0.71	x 0.70	= 2.56 (81)

Solar gains in watts $\Sigma(74)m...(82)m$

68.24	125.02	194.38	279.92	349.20	362.37	342.83	288.75	223.62	144.46	83.34	57.37	(83)
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Total gains - internal and solar (73)m + (83)m

503.45	556.74	609.62	669.69	713.12	702.91	669.55	622.26	571.64	518.13	485.54	480.94	(84)
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7. Mean internal temperature (heating season)

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

												21.00 (85)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.97	0.96	0.93	0.87	0.75	0.59	0.45	0.50	0.72	0.90	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.51	19.70	20.02	20.42	20.74	20.92	20.98	20.97	20.84	20.43	19.90	19.47	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.88	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.95	0.92	0.84	0.70	0.50	0.34	0.39	0.64	0.87	0.95	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.93	18.20	18.65	19.21	19.63	19.83	19.88	19.88	19.75	19.24	18.50	17.88	(90)
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Living area fraction

Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.60	18.84	19.23	19.72	20.10	20.30	20.35	20.34	20.21	19.74	19.10	18.55	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.45	18.69	19.08	19.57	19.95	20.15	20.20	20.19	20.06	19.59	18.95	18.40	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.94	0.91	0.83	0.70	0.52	0.37	0.42	0.65	0.86	0.94	0.96	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

482.35	523.68	551.88	555.60	499.74	368.66	248.51	259.32	372.98	444.15	455.25	463.29	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
------	------	------	------	-------	-------	-------	-------	-------	-------	------	------	------

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1018.18	990.07	901.66	758.30	585.15	390.35	253.08	266.31	421.01	637.91	843.08	1014.34	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

398.66	313.41	260.24	145.94	63.54	0.00	0.00	0.00	0.00	144.16	279.23	409.98	
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Σ(98)1...5, 10...12 = 2015.15 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 35.45 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

440.50	346.31	287.56	161.26	70.21	0.00	0.00	0.00	0.00	159.29	308.55	453.01	
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Σ(211)1...5, 10...12 = 2226.69 (211)

Water heating

Efficiency of water heater

89.63	89.56	89.41	89.06	88.44	87.30	87.30	87.30	87.30	89.02	89.47	89.67	(217)
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Water heating fuel, kWh/month

159.63	140.15	145.91	129.18	125.93	111.72	105.15	118.35	119.07	134.12	143.78	155.01	
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Σ(219a)1...12 = 1588.01 (219)

Annual totals

Space heating fuel - main system 1

2226.69

Water heating fuel

1588.01

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	265.75	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4155.45 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2226.69	x	3.48	x 0.01 =	77.49	(240)
Water heating	1588.01	x	3.48	x 0.01 =	55.26	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	265.75	x	13.19	x 0.01 =	35.05	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	297.70	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.87	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2226.69	x	0.216	=	480.97	(261)
Water heating	1588.01	x	0.216	=	343.01	(264)
Space and water heating				(261) + (262) + (263) + (264) =	823.98	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	265.75	x	0.519	=	137.92	(268)
Total CO ₂ , kg/year				(265)...(271) =	1000.82	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	17.61	(273)
EI value					86.83	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2226.69	x	1.22	=	2716.56	(261)
Water heating	1588.01	x	1.22	=	1937.38	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4653.94	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	265.75	x	3.07	=	815.84	(268)
Primary energy kWh/year					5700.03	(272)
Dwelling primary energy rate kWh/m ² /year					100.28	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BDNF 00CI DS00 Denford Mid Terr Masonry, Classic Range, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	28.42 (1a)	x	2.31 (2a)	=	65.65 (3a)
+1	28.42 (1b)	x	2.56 (2b)	=	72.76 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		56.84 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		138.41 (5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	{6a}
Number of open flues	0	x 20 =	0	{6b}
Number of intermittent fans	3	x 10 =	30	{7a}
Number of passive vents	0	x 10 =	0	{7b}
Number of flueless gas fires	0	x 40 =	0	{7c}
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.22 {8}
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01	{17}
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.47	{18}
Number of sides on which the dwelling is sheltered			2	{19}
Shelter factor		1 - [0.075 x (19)] =	0.85	{20}
Infiltration rate incorporating shelter factor		(18) x (20) =	0.40	{21}
Infiltration rate modified for monthly wind speed:				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.51	0.50	0.49	0.44	0.43	0.38	0.38	0.37	0.40	0.43	0.45	0.47

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Window			9.44	x 1.24	= 11.67		(27)
Door			1.97	x 1.00	= 1.97		(26)
Ground floor			28.42	x 0.13	= 3.69		(28a)
External wall			26.98	x 0.27	= 7.28		(29a)
Party wall			70.23	x 0.00	= 0.00		(32)
Roof			28.42	x 0.11	= 3.13		(30)
Total area of external elements $\sum A$, m ²			95.23				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	27.74	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						193.91	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.95	(36)
Total fabric heat loss					(33) + (36) =	34.69	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
28.69	28.47	28.24	27.20	27.00	26.09	26.09	25.92	26.44	27.00	27.40	27.81	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
63.39	63.16	62.93	61.89	61.69	60.78	60.78	60.61	61.13	61.69	62.09	62.50	
Average = $\Sigma(39)1...12/12 =$											61.89	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.12	1.11	1.11	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.10	
Average = $\Sigma(40)1...12/12 =$											1.09	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.89	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.11	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
87.02	83.86	80.69	77.53	74.37	71.20	71.20	74.37	77.53	80.69	83.86	87.02	
										$\Sigma(44)1...12 =$	949.34	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
129.05	112.87	116.47	101.54	97.43	84.08	77.91	89.40	90.47	105.43	115.09	124.98	
$\sum(45)1...12 =$											1244.74	(45)

Distribution loss 0.15 x (45)m												
19.36	16.93	17.47	15.23	14.61	12.61	11.69	13.41	13.57	15.82	17.26	18.75	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c											
14.03	12.65	13.98	13.50	13.93	13.46	13.89	13.92	13.48	13.96	13.54	14.02

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

143.08	125.52	130.45	115.05	111.36	97.53	91.80	103.32	103.95	119.40	128.63	139.00	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

143.08	125.52	130.45	115.05	111.36	97.53	91.80	103.32	103.95	119.40	128.63	139.00	
$\Sigma(64)1...12 =$											1409.10	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

46.42	40.69	42.22	37.14	35.88	31.32	29.38	33.21	33.45	38.55	41.65	45.06	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	113.46	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

38.07	33.81	27.50	20.82	15.56	13.14	14.20	18.45	24.77	31.45	36.71	39.13	(67)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

246.14	248.69	242.26	228.55	211.26	195.00	184.14	181.59	188.02	201.73	219.02	235.28	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	48.24	(69)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	-75.64	(71)
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Water heating gains (Table 5)

62.39	60.55	56.75	51.58	48.22	43.50	39.49	44.63	46.46	51.81	57.85	60.57	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

435.66	432.12	415.57	390.01	364.10	340.70	326.88	333.73	348.31	374.04	402.64	424.03	(73)
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6. Solar gains

Access factor
Table 6d

Area
m²

Solar flux
W/m²

g
specific data
or Table 6b

FF
specific data
or Table 6c

Gains
W

SouthEast $0.77 \times 3.30 \times 36.79 \times 0.9 \times 0.71 \times 0.70 = 41.82$ (77)

NorthWest $0.77 \times 6.14 \times 11.28 \times 0.9 \times 0.71 \times 0.70 = 23.86$ (81)

Solar gains in watts $\Sigma(74)m...(82)m$

65.68	119.80	184.97	264.47	328.44	340.23	322.12	272.24	212.16	138.08	80.11	55.27	(83)
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Total gains - internal and solar (73)m + (83)m

501.34	551.92	600.54	654.49	692.54	680.93	649.01	605.97	560.47	512.13	482.75	479.31	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.96	0.93	0.86	0.73	0.55	0.41	0.45	0.68	0.89	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.85	20.02	20.29	20.62	20.86	20.97	20.99	20.99	20.92	20.62	20.19	19.82	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.99	19.99	19.99	20.01	20.01	20.03	20.03	20.03	20.02	20.01	20.01	20.00	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.92	0.83	0.67	0.47	0.32	0.36	0.61	0.86	0.95	0.98	(88)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.48	18.73	19.11	19.58	19.88	20.00	20.02	20.02	19.96	19.59	18.99	18.45	(90)
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Living area fraction

Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.06	19.27	19.61	20.02	20.29	20.41	20.43	20.43	20.37	20.03	19.50	19.03	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.91	19.12	19.46	19.87	20.14	20.26	20.28	20.28	20.22	19.88	19.35	18.88	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.96	0.95	0.91	0.83	0.68	0.49	0.34	0.38	0.62	0.85	0.94	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

483.36	522.55	546.48	540.54	472.31	335.24	222.49	233.00	349.56	437.27	455.12	464.49	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

926.22	898.41	815.67	679.06	520.84	344.18	223.91	235.33	373.84	572.41	760.36	917.77	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

329.48	252.58	200.28	99.74	36.10	0.00	0.00	0.00	0.00	100.54	219.78	337.24	
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Σ(98)1...5, 10...12 = 1575.76 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 27.72 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

364.07	279.10	221.30	110.21	39.89	0.00	0.00	0.00	0.00	111.10	242.85	372.65	
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Σ(211)1...5, 10...12 = 1741.17 (211)

Water heating

Efficiency of water heater

89.51	89.41	89.21	88.76	88.06	87.30	87.30	87.30	87.30	88.73	89.29	89.54	(217)
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Water heating fuel, kWh/month

159.85	140.39	146.23	129.62	126.46	111.72	105.15	118.35	119.07	134.55	144.06	155.23	
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Σ(219a)1...12 = 1590.70 (219)

Annual totals

Space heating fuel - main system 1

1741.17

Water heating fuel

1590.70

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	268.94	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3675.81 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1741.17	x	3.48	x 0.01 =	60.59	(240)
Water heating	1590.70	x	3.48	x 0.01 =	55.36	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	268.94	x	13.19	x 0.01 =	35.47	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		281.31	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.16	(257)
SAP value	83.82	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1741.17	x	0.216	=	376.09	(261)
Water heating	1590.70	x	0.216	=	343.59	(264)
Space and water heating			(261) + (262) + (263) + (264) =		719.68	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	268.94	x	0.519	=	139.58	(268)
Total CO ₂ , kg/year			(265)...(271) =		898.19	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		15.80	(273)
EI value					88.18	
EI rating (section 14)					88	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1741.17	x	1.22	=	2124.22	(261)
Water heating	1590.70	x	1.22	=	1940.65	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4064.88	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	268.94	x	3.07	=	825.65	(268)
Primary energy kWh/year					5120.78	(272)
Dwelling primary energy rate kWh/m ² /year					90.09	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BLLE 00HE DS01 Ellerton (Hipped) EOT, Part L 2013 Masonry		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.56 (1a)	x	2.33 (2a)	=	89.84 (3a)
+1	38.56 (1b)	x	2.56 (2b)	=	98.71 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		77.12 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		188.56 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.41 (18)
--	-----------

Number of sides on which the dwelling is sheltered	2 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.85 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.35 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
---	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			12.00	1.24	14.83		(27)
Ground floor			38.56	0.14	5.40		(28a)
External wall			71.96	0.27	19.43		(29a)
Party wall			40.52	0.00	0.00		(32)
Roof			38.56	0.11	4.24		(30)
Total area of external elements $\sum A$, m ²			163.05				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	45.87	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						201.09	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.56	(36)
Total fabric heat loss					(33) + (36) =	52.43	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
37.24	37.00	36.77	35.68	35.47	34.52	34.52	34.34	34.88	35.47	35.89	36.32	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
89.67	89.43	89.20	88.10	87.90	86.94	86.94	86.77	87.31	87.90	88.31	88.75	
Average = $\Sigma(39)1...12/12 =$											88.10	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.16	1.16	1.16	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.15	1.15	
Average = $\Sigma(40)1...12/12 =$											1.14	(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.41											(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.34											(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
100.48	96.82	93.17	89.51	85.86	82.21	82.21	85.86	89.51	93.17	96.82	100.48	
										$\Sigma(44)1...12 =$	1096.09	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
149.00	130.32	134.48	117.24	112.49	97.07	89.95	103.22	104.46	121.73	132.88	144.30	
										$\Sigma(45)1...12 =$	1437.15	(45)

Distribution loss 0.15 x (45)m	22.35	19.55	20.17	17.59	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.65	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c	14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

163.12	143.05	148.53	130.80	126.48	110.58	103.89	117.19	117.99	135.76	146.50	158.40	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

163.12	143.05	148.53	130.80	126.48	110.58	103.89	117.19	117.99	135.76	146.50	158.40	
$\Sigma(64)1...12 =$											1602.30	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.07	46.51	48.23	42.37	40.90	35.65	33.39	37.81	38.12	43.98	47.59	51.51	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

49.88	44.30	36.03	27.28	20.39	17.21	18.60	24.18	32.45	41.20	48.09	51.26	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

318.38	321.69	313.36	295.64	273.26	252.24	238.19	234.88	243.21	260.93	283.31	304.33	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	(71)
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Water heating gains (Table 5)

71.33	69.22	64.82	58.85	54.98	49.52	44.88	50.83	52.94	59.12	66.10	69.23	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

542.55	538.16	517.17	484.73	451.59	421.93	404.63	412.85	431.56	464.21	500.45	527.79	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
NorthEast	0.77	x 6.45	x 11.28	x 0.9 x 0.71	x 0.70	= 25.07	(75)
SouthWest	0.77	x 4.23	x 36.79	x 0.9 x 0.71	x 0.70	= 53.60	(79)
NorthWest	0.77	x 1.32	x 11.28	x 0.9 x 0.71	x 0.70	= 5.13	(81)

Solar gains in watts $\Sigma(74)m...(82)m$

83.80	152.77	235.67	336.66	417.84	432.75	409.76	346.45	270.21	176.03	102.20	70.53	(83)
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Total gains - internal and solar (73)m + (83)m

626.35	690.94	752.84	821.38	869.43	854.68	814.39	759.29	701.77	640.24	602.65	598.32	(84)
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7. Mean internal temperature (heating season)

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

21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.98	0.95	0.90	0.78	0.61	0.46	0.51	0.74	0.92	0.97	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.73	19.90	20.17	20.53	20.80	20.95	20.99	20.98	20.88	20.53	20.08	19.70	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.95	19.95	19.95	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.96	19.96	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.87	0.73	0.53	0.36	0.40	0.67	0.90	0.97	0.98	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.29	18.53	18.92	19.42	19.78	19.94	19.97	19.97	19.88	19.44	18.80	18.25	(90)
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Living area fraction

Living area ÷ (4) = 0.19 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.56	18.78	19.15	19.63	19.97	20.13	20.16	20.16	20.07	19.64	19.03	18.52	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.41	18.63	19.00	19.48	19.82	19.98	20.01	20.01	19.92	19.49	18.88	18.37	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.96	0.93	0.86	0.72	0.53	0.36	0.41	0.66	0.88	0.96	0.98	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

609.44	662.72	699.39	704.08	628.41	451.32	294.22	309.13	465.10	564.28	576.30	584.56	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
------	------	------	------	-------	-------	-------	-------	-------	-------	------	------	------

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1265.14	1228.23	1115.39	931.76	713.51	467.83	296.67	313.22	507.90	781.76	1040.67	1257.65	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

487.84	380.02	309.51	163.93	63.32	0.00	0.00	0.00	0.00	161.81	334.35	500.78	
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Σ(98)1...5, 10...12 = 2401.55 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 31.14 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

539.05	419.91	342.00	181.14	69.96	0.00	0.00	0.00	0.00	178.79	369.44	553.35	
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Σ(211)1...5, 10...12 = 2653.65 (211)

Water heating

Efficiency of water heater

89.68	89.60	89.44	89.05	88.34	87.30	87.30	87.30	87.30	89.01	89.50	89.71	(217)
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Water heating fuel, kWh/month

181.89	159.65	166.08	146.89	143.17	126.66	119.00	134.24	135.16	152.52	163.69	176.57	
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Σ(219a)1...12 = 1805.53 (219)

Annual totals

Space heating fuel - main system 1

2653.65

Water heating fuel

1805.53

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	352.35	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4886.52	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2653.65	x	3.48	x 0.01 =	92.35	(240)
Water heating	1805.53	x	3.48	x 0.01 =	62.83	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	352.35	x	13.19	x 0.01 =	46.47	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	331.55	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.14	(257)
SAP value	84.09	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2653.65	x	0.216	=	573.19	(261)
Water heating	1805.53	x	0.216	=	389.99	(264)
Space and water heating			(261) + (262) + (263) + (264) =		963.18	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	352.35	x	0.519	=	182.87	(268)
Total CO ₂ , kg/year				(265)...(271) =	1184.98	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.37	(273)
EI value					87.00	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2653.65	x	1.22	=	3237.45	(261)
Water heating	1805.53	x	1.22	=	2202.74	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5440.19	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	352.35	x	3.07	=	1081.71	(268)
Primary energy kWh/year					6752.16	(272)
Dwelling primary energy rate kWh/m ² /year					87.55	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BLLE 00CI DS01 Ellerton Mid Terr, Part L2013 Masonry		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.56 (1a)	x	2.33 (2a)	=	89.84 (3a)
+1	38.56 (1b)	x	2.56 (2b)	=	98.71 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		77.12 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		188.56 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.21 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.46 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.39 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.50	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.63	0.62	0.62	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			10.68	1.24	13.20		(27)
Ground floor			38.56	0.12	4.63		(28a)
External wall			32.76	0.27	8.85		(29a)
Party wall			81.04	0.00	0.00		(32)
Roof			38.56	0.11	4.24		(30)
Total area of external elements $\sum A$, m ²			122.53				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	32.88	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						214.74	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						5.84	(36)
Total fabric heat loss					(33) + (36) =	38.72	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
38.93	38.63	38.33	36.93	36.67	35.45	35.45	35.23	35.92	36.67	37.20	37.75	(38)

Heat transfer coefficient, W/K (37)m + (38)m											
77.65	77.35	77.05	75.65	75.39	74.17	74.17	73.95	74.64	75.39	75.92	76.47
Average = $\sum(39)1...12/12 =$										75.65	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)											
1.01	1.00	1.00	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.98	0.99
Average = $\sum(40)1...12/12 =$										0.98	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.34	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
100.48	96.82	93.17	89.51	85.86	82.21	82.21	85.86	89.51	93.17	96.82	100.48
$\sum(44)1...12 =$										1096.09	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)											
149.00	130.32	134.48	117.24	112.49	97.07	89.95	103.22	104.46	121.73	132.88	144.30
$\sum(45)1...12 =$										1437.15	(45)

Distribution loss 0.15 x (45)m												
22.35	19.55	20.17	17.59	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.65	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

163.12	143.05	148.53	130.80	126.48	110.58	103.89	117.19	117.99	135.76	146.50	158.40	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

163.12	143.05	148.53	130.80	126.48	110.58	103.89	117.19	117.99	135.76	146.50	158.40	
$\Sigma(64)1...12 =$											1602.30	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.07	46.51	48.23	42.37	40.90	35.65	33.39	37.81	38.12	43.98	47.59	51.51	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	144.36	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

51.13	45.41	36.93	27.96	20.90	17.64	19.06	24.78	33.26	42.23	49.29	52.55	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

318.38	321.69	313.36	295.64	273.26	252.24	238.19	234.88	243.21	260.93	283.31	304.33	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	-96.24	(71)
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Water heating gains (Table 5)

71.33	69.22	64.82	58.85	54.98	49.52	44.88	50.83	52.94	59.12	66.10	69.23	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

543.80	539.27	518.07	485.41	452.10	422.36	405.10	413.45	432.37	465.24	501.65	529.07	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
NorthEast	0.77	x 6.45	x 11.28	x 0.9 x 0.71	x 0.70	= 25.07	(75)
SouthWest	0.77	x 4.23	x 36.79	x 0.9 x 0.71	x 0.70	= 53.60	(79)

Solar gains in watts $\Sigma(74)m...(82)m$

78.67	142.33	216.86	305.76	376.31	388.47	368.34	313.43	247.29	163.27	95.74	66.34	(83)
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Total gains - internal and solar (73)m + (83)m

622.47	681.60	734.93	791.17	828.41	810.83	773.43	726.88	679.66	628.51	597.40	595.41	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.95	0.89	0.76	0.57	0.42	0.46	0.70	0.91	0.97	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.04	20.18	20.41	20.70	20.90	20.98	21.00	20.99	20.95	20.70	20.33	20.01	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.08	20.08	20.08	20.10	20.10	20.12	20.12	20.12	20.11	20.10	20.10	20.09	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.86	0.71	0.50	0.34	0.38	0.63	0.88	0.97	0.99	(98)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.81	19.02	19.35	19.76	20.00	20.10	20.11	20.12	20.07	19.77	19.25	18.79	(90)
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Living area fraction

Living area ÷ (4) = 0.19 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.04	19.24	19.55	19.93	20.17	20.27	20.28	20.28	20.23	19.94	19.45	19.01	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.89	19.09	19.40	19.78	20.02	20.12	20.13	20.13	20.08	19.79	19.30	18.86	(93)
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5. Space heating requirement

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

Utilisation factor for gains, ηm

0.98	0.96	0.93	0.85	0.70	0.50	0.34	0.38	0.63	0.87	0.96	0.98	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

607.56	655.81	683.94	673.22	581.58	403.00	261.03	274.58	427.13	548.78	572.34	583.44	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1132.71	1097.26	993.74	823.19	627.20	409.14	261.69	275.75	446.53	692.99	926.06	1121.48	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

390.71	296.65	230.50	107.98	33.94	0.00	0.00	0.00	0.00	107.29	254.67	400.30	
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Σ(98)1...5, 10...12 = 1822.04 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 23.63 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

431.72	327.79	254.69	119.31	37.50	0.00	0.00	0.00	0.00	118.55	281.41	442.32	
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Σ(211)1...5, 10...12 = 2013.30 (211)

Water heating

Efficiency of water heater

89.53	89.43	89.22	88.72	87.96	87.30	87.30	87.30	87.30	88.68	89.30	89.57	(217)
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Water heating fuel, kWh/month

182.18	159.95	166.48	147.44	143.80	126.66	119.00	134.24	135.16	153.08	164.05	176.85	
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Σ(219a)1...12 = 1808.90 (219)

Annual totals

Space heating fuel - main system 1

2013.30

Water heating fuel

1808.90

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	361.16	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4258.36 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2013.30	x	3.48	x 0.01 =	70.06	(240)
Water heating	1808.90	x	3.48	x 0.01 =	62.95	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	361.16	x	13.19	x 0.01 =	47.64	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		310.54	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.07	(257)
SAP value	85.10	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2013.30	x	0.216	=	434.87	(261)
Water heating	1808.90	x	0.216	=	390.72	(264)
Space and water heating			(261) + (262) + (263) + (264) =		825.60	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	361.16	x	0.519	=	187.44	(268)
Total CO ₂ , kg/year			(265)...(271) =		1051.96	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		13.64	(273)
EI value					88.46	
EI rating (section 14)					88	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2013.30	x	1.22	=	2456.23	(261)
Water heating	1808.90	x	1.22	=	2206.86	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4663.08	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	361.16	x	3.07	=	1108.77	(268)
Primary energy kWh/year					6002.10	(272)
Dwelling primary energy rate kWh/m ² /year					77.83	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	1st Floor Flat 2 Storey, Yapton		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	51.01 (1a)	x	2.40 (2a)	=	122.42 (3a)
+1	31.05 (1b)	x	2.69 (2b)	=	83.52 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		82.06 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		205.95 (5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20	÷ (5) =	0.10	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.35	(18)
Number of sides on which the dwelling is sheltered			1	(19)
Shelter factor		1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.32	(21)
Infiltration rate modified for monthly wind speed:				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.41	0.40	0.39	0.35	0.35	0.31	0.31	0.30	0.32	0.35	0.36	0.38

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			2.12	0.81	1.72		(26)
Window			5.46	1.24	6.75		(27)
Roof window			2.06	1.59	3.28		(27a)
External wall			54.58	0.29	15.83		(29a)
External wall			47.37	0.34	16.11		(29a)
External wall			17.58	0.23	4.04		(29a)
External wall			10.46	0.25	2.62		(29a)
Party wall			14.10	0.00	0.00		(32)
Roof			40.38	0.11	4.44		(30)
Roof			8.57	0.16	1.37		(30)
Total area of external elements ΣA, m ²			188.58				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	56.15	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						200.01	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						9.02	(36)
Total fabric heat loss						(33) + (36) =	65.17 (37)

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

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

39.69	39.47	39.25	38.23	38.04	37.15	37.15	36.99	37.49	38.04	38.43	38.83	(38)
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Heat transfer coefficient, W/K (37)m + (38)m

104.86	104.64	104.43	103.40	103.21	102.32	102.32	102.16	102.67	103.21	103.60	104.00	
Average = Σ(39)1...12/12 =											103.40	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.28	1.28	1.27	1.26	1.26	1.25	1.25	1.24	1.25	1.26	1.26	1.27	
Average = Σ(40)1...12/12 =											1.26	(40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N 2.50 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 93.59 (43)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

102.95	99.21	95.47	91.72	87.98	84.23	84.23	87.98	91.72	95.47	99.21	102.95	
Σ(44)1...12 =											1123.12	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

152.68	133.53	137.79	120.13	115.27	99.47	92.17	105.77	107.03	124.74	136.16	147.86	
Σ(45)1...12 =											1472.59	(45)

Distribution loss 0.15 x (45)m

22.90	20.03	20.67	18.02	17.29	14.92	13.83	15.87	16.05	18.71	20.42	22.18	(46)
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Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.12	12.74	14.07	13.58	14.00	13.51	13.94	13.98	13.55	14.04	13.64	14.11	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.80	146.27	151.87	133.71	129.27	112.98	106.11	119.75	120.58	138.78	149.80	161.97	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

166.80	146.27	151.87	133.71	129.27	112.98	106.11	119.75	120.58	138.78	149.80	161.97	
$\Sigma(64)1...12 =$											1637.88	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

54.30	47.59	49.33	43.34	41.83	36.45	34.13	38.66	38.98	44.99	48.68	52.69	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

150.05	150.05	150.05	150.05	150.05	150.05	150.05	150.05	150.05	150.05	150.05	150.05	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

56.36	50.06	40.71	30.82	23.04	19.45	21.02	27.32	36.67	46.56	54.34	57.93	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

333.87	337.33	328.60	310.02	286.55	264.50	249.77	246.31	255.04	273.63	297.09	319.14	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.51	52.51	52.51	52.51	52.51	52.51	52.51	52.51	52.51	52.51	52.51	52.51	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	-100.03	(71)
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Water heating gains (Table 5)

72.98	70.81	66.31	60.19	56.22	50.63	45.88	51.97	54.13	60.46	67.61	70.82	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

568.73	563.72	541.14	506.55	471.33	440.10	422.19	431.11	451.36	486.17	524.56	553.41	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	1.00	x	3.69	x	19.64	x 0.9 x	0.72	x	0.70	=	32.87	(80)
East	1.00	x	1.77	x	19.64	x 0.9 x	0.72	x	0.70	=	15.77	(76)
East	1.00	x	1.03	x	26.46	x 0.9 x	0.72	x	0.70	=	12.36	(76)
West	1.00	x	1.03	x	26.46	x 0.9 x	0.72	x	0.70	=	12.36	(80)

Solar gains in watts $\Sigma(74)m...(82)m$

73.37	144.96	242.36	359.24	445.45	458.31	435.38	370.50	283.74	172.96	91.74	60.17	(83)
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Total gains - internal and solar (73)m + (83)m

642.10	708.69	783.50	865.79	916.79	898.42	857.57	801.62	735.10	659.13	616.30	613.58	(84)
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7. Mean internal temperature (heating season)

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

21.00	(85)
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.96	0.91	0.82	0.66	0.50	0.56	0.78	0.94	0.98	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.52	19.69	19.99	20.39	20.72	20.91	20.98	20.97	20.82	20.40	19.89	19.49	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.87	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.95	0.89	0.76	0.57	0.39	0.43	0.71	0.92	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.92	18.16	18.60	19.16	19.59	19.82	19.87	19.87	19.73	19.19	18.46	17.88	(90)
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Living area fraction

Living area ÷ (4) = 0.27 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.35	18.57	18.97	19.49	19.90	20.12	20.17	20.16	20.03	19.51	18.85	18.31	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.20	18.42	18.82	19.34	19.75	19.97	20.02	20.01	19.88	19.36	18.70	18.16	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.98	0.97	0.94	0.87	0.76	0.57	0.40	0.45	0.71	0.90	0.96	0.98	(94)
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Useful gains, ηmGm, W (94)m x (84)m

627.13	684.09	735.28	757.55	693.57	515.91	343.89	359.79	518.31	594.18	593.74	601.32	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1457.68	1415.15	1287.01	1079.73	830.42	548.98	349.85	369.12	592.99	904.13	1201.41	1451.88	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

617.93	491.27	410.49	231.98	101.82	0.00	0.00	0.00	0.00	230.61	437.53	632.81	(98)
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Σ(98)1...5, 10...12 = 3154.43 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 38.44 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (203)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

682.80	542.84	453.58	256.33	112.51	0.00	0.00	0.00	0.00	254.81	483.45	699.24	(211)
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Σ(211)1...5, 10...12 = 3485.56 (211)

Water heating

Efficiency of water heater

89.80	89.75	89.61	89.30	88.68	87.30	87.30	87.30	87.30	89.27	89.66	89.83	(217)
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Water heating fuel, kWh/month

185.74	162.99	169.47	149.72	145.77	129.42	121.55	137.17	138.12	155.46	167.07	180.31	
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$$\Sigma(219a)1...12 = 1842.79 \quad (219)$$

Annual totals

Space heating fuel - main system 1		3485.56	
Water heating fuel		1842.79	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		398.14	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5801.49	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3485.56	x	3.48	x 0.01 =	121.30	(240)
Water heating	1842.79	x	3.48	x 0.01 =	64.13	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	398.14	x	13.19	x 0.01 =	52.51	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		367.83	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.22	(257)
SAP value	83.04	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3485.56	x	0.216	=	752.88	(261)
Water heating	1842.79	x	0.216	=	398.04	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1150.92	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	398.14	x	0.519	=	206.63	(268)
Total CO ₂ , kg/year			(265)...(271) =		1396.48	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		17.02	(273)
EI value					85.27	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3485.56	x	1.22	=	4252.39	(261)
Water heating	1842.79	x	1.22	=	2248.20	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6500.59	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	398.14	x	3.07	=	1222.29	(268)

Primary energy kWh/year

7953.13	(272)
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Dwelling primary energy rate kWh/m2/year

96.92	(273)
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This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	Flat GF, Yapton		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	53.46 (1a)	2.31 (2a)	123.49 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 53.46 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	123.49 (5)

2. Ventilation rate

		m ³ per hour
Number of chimneys	0	0 (6a)
Number of open flues	0	0 (6b)
Number of intermittent fans	3	30 (7a)
Number of passive vents	0	0 (7b)
Number of flueless gas fires	0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30 ÷ (5) = 0.24 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.49 (18)
Number of sides on which the dwelling is sheltered	1 (19)
Shelter factor	1 - [0.075 x (19)] = 0.93 (20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.46 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.58	0.57	0.56	0.50	0.49	0.43	0.43	0.42	0.46	0.49	0.51	0.54
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

	0.67	0.66	0.66	0.63	0.62	0.59	0.59	0.59	0.60	0.62	0.63	0.64
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.67	0.66	0.66	0.63	0.62	0.59	0.59	0.59	0.60	0.62	0.63	0.64
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Window			6.68	x 1.24	= 8.25		(27)						
Door			1.93	x 0.81	= 1.56		(26)						
Ground floor			53.46	x 0.14	= 7.48		(28a)						
External wall			50.78	x 0.29	= 14.73		(29a)						
External wall			14.26	x 0.25	= 3.57		(29a)						
Total area of external elements ΣA, m ²			127.11				(31)						
Fabric heat loss, W/K = Σ(A × U)						(26)...(30) + (32) =	35.59 (33)						
Heat capacity Cm = Σ(A × κ)						(28)...(30) + (32) + (32a)...(32e) =	N/A (34)						
Thermal mass parameter (TMP) in kJ/m ² K							210.56 (35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K							7.36 (36)						
Total fabric heat loss						(33) + (36) =	42.95 (37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	27.28	27.01	26.75	25.51	25.28	24.21	24.21	24.01	24.62	25.28	25.75	26.24	(38)
Heat transfer coefficient, W/K (37)m + (38)m	70.23	69.96	69.70	68.46	68.23	67.16	67.16	66.96	67.57	68.23	68.70	69.19	
	Average = Σ(39)1...12/12 =											68.46 (39)	
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.31	1.31	1.30	1.28	1.28	1.26	1.26	1.25	1.26	1.28	1.29	1.29	
	Average = Σ(40)1...12/12 =											1.28 (40)	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N

1.79

{42}

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.76

{43}

JanFebMarAprMayJunJulAugSepOctNovDec

Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x {43}

84.44	81.37	78.30	75.23	72.16	69.09	69.09	72.16	75.23	78.30	81.37	84.44
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$\Sigma\{44\}1...12 =$

921.15

{44}

Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)

125.22	109.52	113.01	98.53	94.54	81.58	75.60	86.75	87.78	102.30	111.67	121.27
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$\Sigma\{45\}1...12 =$

1207.78

{45}

Distribution loss $0.15 \times \{45\}m$

18.78	16.43	16.95	14.78	14.18	12.24	11.34	13.01	13.17	15.35	16.75	18.19
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{46}

Water storage loss calculated for each month $\{55\} \times \{41\}m$

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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{56}

If the vessel contains dedicated solar storage or dedicated WWHRs $\{56\}m \times [\{47\} - V_s] \div \{47\}$, else {56}

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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{57}

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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{59}

Combi loss for each month from Table 3a, 3b or 3c

14.01	12.64	13.97	13.49	13.92	13.45	13.88	13.91	13.47	13.95	13.53	14.00
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{61}

Total heat required for water heating calculated for each month $0.85 \times \{45\}m + \{46\}m + \{57\}m + \{59\}m + \{61\}m$

139.23	122.16	126.98	112.02	108.46	95.03	89.48	100.65	101.26	116.25	125.20	135.27
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{62}

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

139.23	122.16	126.98	112.02	108.46	95.03	89.48	100.65	101.26	116.25	125.20	135.27	
$\Sigma(64)1...12 =$											1372.00	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

45.14	39.57	41.07	36.13	34.91	30.49	28.61	32.32	32.56	37.50	40.51	43.82	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
107.53	107.53	107.53	107.53	107.53	107.53	107.53	107.53	107.53	107.53	107.53	107.53	(66)

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

38.30	34.02	27.66	20.94	15.66	13.22	14.28	18.56	24.92	31.64	36.92	39.36	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

233.15	235.57	229.47	216.49	200.11	184.71	174.42	172.00	178.10	191.08	207.46	222.86	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

47.54	47.54	47.54	47.54	47.54	47.54	47.54	47.54	47.54	47.54	47.54	47.54	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	-71.68	(71)
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Water heating gains (Table 5)

60.67	58.89	55.20	50.18	46.93	42.34	38.45	43.44	45.22	50.41	56.27	58.90	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

418.50	414.86	398.72	374.01	349.08	326.66	313.54	320.39	334.62	359.51	387.04	407.51	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	3.72	x	19.64	x 0.9 x	0.74	x	0.70	=	26.23	(76)
North	0.77	x	1.10	x	10.63	x 0.9 x	0.74	x	0.70	=	4.20	(74)
West	0.77	x	1.86	x	19.64	x 0.9 x	0.74	x	0.70	=	13.11	(80)

Solar gains in watts $\Sigma(74)m...(82)m$

43.54	84.98	140.38	206.75	256.04	263.48	250.26	213.04	163.80	100.87	54.23	35.85	(83)
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Total gains - internal and solar (73)m + (83)m

462.04	499.84	539.10	580.75	605.11	590.14	563.80	533.43	498.42	460.38	441.28	443.36	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)											21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.98	0.96	0.91	0.82	0.66	0.51	0.55	0.78	0.93	0.98	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.61	19.76	20.04	20.42	20.73	20.92	20.98	20.97	20.84	20.45	19.98	19.59	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.83	19.83	19.84	19.86	19.86	19.88	19.88	19.88	19.87	19.86	19.85	19.85	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.95	0.89	0.77	0.57	0.39	0.43	0.69	0.91	0.97	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.02	18.24	18.65	19.19	19.59	19.82	19.87	19.87	19.74	19.24	18.57	18.00	(90)
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Living area fraction

Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.67	18.86	19.22	19.69	20.06	20.27	20.32	20.32	20.19	19.74	19.14	18.65	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.52	18.71	19.07	19.54	19.91	20.12	20.17	20.17	20.04	19.59	18.99	18.50	(93)
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6. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.97	0.96	0.94	0.88	0.77	0.59	0.42	0.46	0.71	0.90	0.96	0.98	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

450.12	481.66	506.31	511.64	465.95	348.21	235.68	246.02	353.16	413.49	423.58	433.42	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

998.43	966.37	875.87	728.51	560.11	370.78	239.87	252.26	401.60	613.23	817.10	989.31	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

407.95	325.73	274.95	156.15	70.05	0.00	0.00	0.00	0.00	148.60	283.34	413.59	
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Σ(98)1...5, 10...12 = 2080.36 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 38.91 (99)

9a. Energy requirement - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

450.77	359.92	303.82	172.54	77.41	0.00	0.00	0.00	0.00	164.20	313.08	457.00	
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Σ(211)1...5, 10...12 = 2298.73 (211)

Water heating

Efficiency of water heater

89.66	89.60	89.46	89.14	88.53	87.30	87.30	87.30	87.30	89.07	89.49	89.69	(217)
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Water heating fuel, kWh/month

155.28	136.33	141.94	125.67	122.51	108.85	102.50	115.30	115.99	130.52	139.90	150.82	
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Σ(219a)1...12 = 1545.61 (219)

Annual totals

Space heating fuel - main system 1

2298.73

Water heating fuel

1545.61

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan

45.00

(230e)

Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					270.55	(232)
Total delivered energy for all uses				(211)...(221) + (231) + (232)...(237b) =	4189.89	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2298.73	x	3.48	x 0.01 =	80.00	(240)
Water heating	1545.61	x	3.48	x 0.01 =	53.79	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	270.55	x	13.19	x 0.01 =	35.69	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	299.36	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.19	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2298.73	x	0.216	=	496.53	(261)
Water heating	1545.61	x	0.216	=	333.85	(264)
Space and water heating				(261) + (262) + (263) + (264) =	830.38	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	270.55	x	0.519	=	140.41	(268)
Total CO ₂ , kg/year				(265)...(271) =	1009.72	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	18.89	(273)
EI value					86.26	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2298.73	x	1.22	=	2804.46	(261)
Water heating	1545.61	x	1.22	=	1885.65	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4690.10	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	270.55	x	3.07	=	830.58	(268)
Primary energy kWh/year					5750.93	(272)
Dwelling primary energy rate kWh/m ² /year					107.57	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	21/10/2021
Address	H403--G7 DS04 Ingelby (Gable Roof) Detached Part L2013 Masonry, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	49.50 (1a)	x	2.31 (2a)	=	114.35 (3a)
+1	49.50 (1b)	x	2.56 (2b)	=	126.72 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		99.00 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		241.07 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.17 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.42 (18)
Number of sides on which the dwelling is sheltered			0 (19)
Shelter factor		1 - [0.075 x (19)] =	1.00 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.42 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.53	0.52	0.51	0.46	0.45	0.40	0.40	0.39	0.42	0.45	0.47	0.49

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.64	0.64	0.63	0.60	0.60	0.58	0.58	0.57	0.59	0.60	0.61	0.62
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.64	0.64	0.63	0.60	0.60	0.58	0.58	0.57	0.59	0.60	0.61	0.62	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Window			14.06	1.24	17.37		(27)
Door			2.38	1.10	2.62		(26)
Ground floor			49.50	0.14	6.93		(28a)
External wall			124.00	0.27	33.48		(29a)
Roof			49.50	0.11	5.45		(30)
Total area of external elements ΣA, m ²			239.44				(31)
Fabric heat loss, W/K = Σ(A x U)						(26)...(30) + (32) =	65.85 (33)
Heat capacity Cm = Σ(A x κ)						(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m ² K							160.36 (35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							6.90 (36)
Total fabric heat loss						(33) + (36) =	72.74 (37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
50.99	50.55	50.13	48.12	47.75	46.00	46.00	45.68	46.67	47.75	48.51	49.30	(38)

Heat transfer coefficient, W/K (37)m + (38)m	123.73	123.30	122.87	120.87	120.49	118.75	118.75	118.42	119.42	120.49	121.25	122.04	
Average = Σ(39)1...12/12 =	120.86 (39)												

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.25	1.25	1.24	1.22	1.22	1.20	1.20	1.20	1.21	1.22	1.22	1.23	
Average = Σ(40)1...12/12 =	1.22 (40)												

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.73	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.04	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
	108.94	104.98	101.02	97.06	93.10	89.14	89.14	93.10	97.06	101.02	104.98	108.94
	Σ(44)1...12 =											1188.47 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	161.56	141.30	145.81	127.12	121.98	105.26	97.53	111.92	113.26	131.99	144.08	156.46	
Σ(45)1...12 =	1558.27 (45)												

Distribution loss 0.15 x (45)m	24.23	21.20	21.87	19.07	18.30	15.79	14.63	16.79	16.99	19.80	21.61	23.47	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c	14.14	12.76	14.11	13.61	14.03	13.54	13.97	14.01	13.58	14.07	13.66	14.13	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.70	154.07	159.92	140.73	136.00	118.79	111.50	125.93	126.84	146.07	157.74	170.59	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

175.70	154.07	159.92	140.73	136.00	118.79	111.50	125.93	126.84	146.07	157.74	170.59	
$\Sigma(64)1...12 =$											1723.88	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

57.25	50.17	52.01	45.67	44.06	38.38	35.92	40.72	41.05	47.41	51.32	55.56	(65)
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5. Internal gains

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

163.80	163.80	163.80	163.80	163.80	163.80	163.80	163.80	163.80	163.80	163.80	163.80	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

60.71	53.92	43.85	33.20	24.82	20.95	22.64	29.43	39.50	50.15	58.53	62.40	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

380.15	384.10	374.15	352.99	326.28	301.17	284.40	280.45	290.39	311.56	338.27	363.38	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.11	54.11	54.11	54.11	54.11	54.11	54.11	54.11	54.11	54.11	54.11	54.11	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	-109.20	(71)
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Water heating gains (Table 5)

76.96	74.66	69.90	63.43	59.23	53.31	48.28	54.73	57.02	63.72	71.28	74.67	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

629.53	624.39	599.62	561.33	522.03	487.14	467.03	476.32	498.62	537.14	579.79	612.16	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 4.29	x 19.64	x 0.9 x 0.71	x 0.70	= 29.02	(80)
East	0.77	x 7.13	x 19.64	x 0.9 x 0.71	x 0.70	= 48.23	(76)
South	0.77	x 1.98	x 46.75	x 0.9 x 0.71	x 0.70	= 31.88	(78)
North	0.77	x 0.66	x 10.63	x 0.9 x 0.71	x 0.70	= 2.42	(74)

Solar gains in watts $\Sigma(74)m...(82)m$

111.55	207.95	323.23	450.75	540.15	548.93	524.15	457.39	368.37	241.13	137.10	93.09	(83)
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Total gains - internal and solar (73)m + (83)m

741.08	832.35	922.86	1012.08	1062.18	1036.07	991.18	933.71	866.99	778.27	716.89	705.25	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.95	0.89	0.80	0.64	0.50	0.54	0.76	0.92	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.27	19.48	19.82	20.27	20.64	20.88	20.96	20.95	20.78	20.30	19.71	19.24	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.88	19.88	19.89	19.90	19.91	19.92	19.92	19.92	19.92	19.91	19.90	19.89	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.93	0.87	0.75	0.56	0.39	0.43	0.68	0.89	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.60	17.90	18.40	19.04	19.53	19.83	19.90	19.90	19.72	19.09	18.26	17.57	(90)
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Living area fraction

Living area ÷ (4) = 0.15 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.86	18.14	18.62	19.23	19.70	19.99	20.07	20.06	19.88	19.28	18.48	17.83	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.71	17.99	18.47	19.08	19.55	19.84	19.92	19.91	19.73	19.13	18.33	17.68	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.95	0.91	0.84	0.73	0.56	0.39	0.43	0.67	0.87	0.94	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

713.27	787.04	841.66	853.55	773.37	575.03	383.96	401.34	580.31	675.83	676.84	682.23	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1659.12	1614.58	1470.89	1230.52	946.28	622.01	393.70	415.46	672.75	1027.47	1361.85	1644.60	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

703.71	556.10	468.14	271.42	128.65	0.00	0.00	0.00	0.00	261.62	493.21	716.00	
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Σ(98)1...5, 10...12 = 3598.85 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 36.35 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

777.58	614.48	517.28	299.91	142.15	0.00	0.00	0.00	0.00	289.08	544.99	791.16	
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Σ(211)1...5, 10...12 = 3976.63 (211)

Water heating

Efficiency of water heater

89.84	89.79	89.66	89.38	88.83	87.30	87.30	87.30	87.30	89.33	89.70	89.87	(217)
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Water heating fuel, kWh/month

195.57	171.59	178.35	157.45	153.11	136.07	127.72	144.25	145.29	163.52	175.85	189.83	
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Σ(219a)1...12 = 1938.60 (219)

Annual totals

Space heating fuel - main system 1

3976.63

Water heating fuel

1938.60

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	428.87	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 6419.11	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3976.63	x	3.48	x 0.01 =	138.39	(240)
Water heating	1938.60	x	3.48	x 0.01 =	67.46	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	428.87	x	13.19	x 0.01 =	56.57	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	392.31	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.14	(257)
SAP value	84.04	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3976.63	x	0.216	=	858.95	(261)
Water heating	1938.60	x	0.216	=	418.74	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1277.69	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	428.87	x	0.519	=	222.59	(268)
Total CO ₂ , kg/year				(265)...(271) =	1539.20	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.55	(273)
EI value					85.68	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3976.63	x	1.22	=	4851.49	(261)
Water heating	1938.60	x	1.22	=	2365.09	(264)
Space and water heating				(261) + (262) + (263) + (264) =	7216.59	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	428.87	x	3.07	=	1316.64	(268)
Primary energy kWh/year					8763.48	(272)
Dwelling primary energy rate kWh/m ² /year					88.52	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	Bradgate (H417---7) Detached, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	70.67 (1a)	x	2.33 (2a)	=	164.66 (3a)
+1	64.38 (1b)	x	2.64 (2b)	=	169.96 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		135.05 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		334.62 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	5	x 10 =	50 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 50	÷ (5) =	0.15 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.40 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.34 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.42	0.37	0.37	0.32	0.32	0.31	0.34	0.37	0.38	0.40

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.12	x 1.10	= 2.33		(26)						
Door			1.97	x 1.50	= 2.96		(26)						
Window			26.73	x 1.24	= 33.03		(27)						
Ground floor			70.15	x 0.14	= 9.82		(28a)						
External wall			135.31	x 0.27	= 36.53		(29a)						
Roof			64.38	x 0.11	= 7.08		(30)						
Roof			5.80	x 0.17	= 0.99		(30)						
Total area of external elements ΣA, m ²			306.46				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	92.74	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						173.00	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						15.50	(36)						
Total fabric heat loss					(33) + (36) =	108.25	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	65.58	65.18	64.79	62.93	62.59	60.97	60.97	60.67	61.59	62.59	63.29	64.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	173.83	173.43	173.03	171.18	170.83	169.22	169.22	168.92	169.84	170.83	171.53	172.27	
	Average = Σ(39)1...12/12 =											171.18	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.29	1.28	1.28	1.27	1.26	1.25	1.25	1.25	1.26	1.26	1.27	1.28	
	Average = Σ(40)1...12/12 =											1.27	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.91	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												103.24	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	113.57	109.44	105.31	101.18	97.05	92.92	92.92	97.05	101.18	105.31	109.44	113.57		
												$\Sigma(44)_{1...12} =$	1238.90	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	168.41	147.30	152.00	132.51	127.15	109.72	101.67	116.67	118.06	137.59	150.19	163.10		
												$\Sigma(45)_{1...12} =$	1624.39	(45)
Distribution loss $0.15 \times (45)_m$														
	25.26	22.09	22.80	19.88	19.07	16.46	15.25	17.50	17.71	20.64	22.53	24.47	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												150.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												0.96	(48)	
Temperature factor from Table 2b												0.54	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												0.52	(50)	
Enter (50) or (54) in (55)												0.52	(55)	
Water storage loss calculated for each month $(55) \times (41)_m$														

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

207.75	182.82	191.33	170.58	166.48	147.79	141.01	156.00	156.13	176.93	188.26	202.43	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-52.39	-46.10	-47.05	-38.70	-35.92	-29.63	-25.07	-30.36	-31.25	-38.63	-44.76	-50.64	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

155.36	136.73	144.28	131.88	130.56	118.15	115.94	125.65	124.88	138.29	143.49	151.80	
$\Sigma(64)1...12 =$											1617.01	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

87.46	77.40	82.01	74.51	73.74	66.93	65.27	70.26	69.71	77.22	80.39	85.70	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

174.42	174.42	174.42	174.42	174.42	174.42	174.42	174.42	174.42	174.42	174.42	174.42	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

68.24	60.61	49.29	37.32	27.90	23.55	25.45	33.08	44.40	56.37	65.79	70.14	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

453.30	458.00	446.15	420.91	389.06	359.12	339.12	334.42	346.27	371.50	403.36	433.30	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

55.35	55.35	55.35	55.35	55.35	55.35	55.35	55.35	55.35	55.35	55.35	55.35	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	-116.28	(71)
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Water heating gains (Table 5)

117.56	115.17	110.22	103.49	99.12	92.96	87.73	94.43	96.82	103.78	111.65	115.18	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

755.59	750.28	722.15	678.21	632.56	592.12	568.79	578.42	603.97	648.15	697.30	735.11	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.58	x	46.75	x 0.9 x	0.71	x	0.70	=	202.57	(78)
East	0.77	x	3.36	x	19.64	x 0.9 x	0.71	x	0.70	=	22.73	(76)
West	0.77	x	3.36	x	19.64	x 0.9 x	0.71	x	0.70	=	22.73	(80)
North	0.77	x	5.75	x	10.63	x 0.9 x	0.71	x	0.70	=	21.06	(74)
NorthEast	0.77	x	0.84	x	11.28	x 0.9 x	0.71	x	0.70	=	3.26	(75)
NorthWest	0.77	x	0.84	x	11.28	x 0.9 x	0.71	x	0.70	=	3.26	(81)

Solar gains in watts $\Sigma(74)m...(82)m$

275.61	474.21	661.37	840.37	960.29	961.69	923.70	832.97	723.17	527.49	330.99	235.31	(83)
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Total gains - internal and solar (73)m + (83)m

1031.20	1224.49	1383.52	1518.58	1592.86	1553.81	1492.49	1411.39	1327.14	1175.64	1028.28	970.42	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.94	0.88	0.78	0.62	0.48	0.52	0.73	0.91	0.97	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.32	19.57	19.92	20.35	20.69	20.90	20.97	20.96	20.82	20.36	19.76	19.27	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.85	19.85	19.86	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.93	0.85	0.73	0.54	0.36	0.41	0.65	0.88	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.64	18.00	18.51	19.11	19.55	19.80	19.86	19.86	19.72	19.15	18.29	17.58	(90)
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Living area fraction Living area ÷ (4) = 0.14 (91)

Mean internal temperature for the whole dwelling $fLA \times T1 + (1 - fLA) \times T2$

17.87	18.22	18.70	19.27	19.71	19.95	20.01	20.01	19.87	19.31	18.49	17.81	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.72	18.07	18.55	19.12	19.56	19.80	19.86	19.86	19.72	19.16	18.34	17.66	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, η_m

0.97	0.94	0.90	0.83	0.71	0.53	0.36	0.40	0.64	0.86	0.95	0.97	(94)
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Useful gains, $\eta_m G_m$, W (94)m x (84)m

996.98	1156.00	1252.08	1261.65	1128.56	825.46	542.11	569.15	847.23	1005.98	972.65	943.39	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, L_m , W [(39)m x [(93)m - (96)m]

2332.77	2283.48	2085.58	1750.06	1342.31	880.09	552.36	584.22	954.37	1462.72	1928.45	2318.62	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)m - (95)m] \times (41)m$

993.83	757.67	620.12	351.66	159.03	0.00	0.00	0.00	0.00	339.81	688.18	1023.17	
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$\Sigma(98)1...5, 10...12 = 4933.47$ (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 36.53 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 90.30 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

1100.59	839.06	686.74	389.43	176.12	0.00	0.00	0.00	0.00	376.32	762.10	1133.08	
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$\Sigma(211)1...5, 10...12 = 5463.42$ (211)

Water heating

Efficiency of water heater

88.69	88.48	88.07	87.11	85.14	79.60	79.60	79.60	79.60	86.92	88.25	88.76	(217)
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Water heating fuel, kWh/month

175.17	154.53	163.84	151.40	153.35	148.43	145.65	157.85	156.89	159.10	162.59	171.02	
$\Sigma(219a)1...12 =$											1899.82	(219)

Annual totals

Space heating fuel - main system 1

5463.42

Water heating fuel

1899.82

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan

45.00

(230e)

Total electricity for the above, kWh/year

75.00

(231)

Electricity for lighting (Appendix L)

482.08

(232)

Total delivered energy for all uses

$(211)...(221) + (231) + (232)...(237b) =$ 7920.32

(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5463.42	x	3.48	x 0.01 =	190.13	(240)
Water heating	1899.82	x	3.48	x 0.01 =	66.11	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	482.08	x	13.19	x 0.01 =	63.59	(250)
Additional standing charges					120.00	(251)
Total energy cost				$(240)...(242) + (245)...(254) =$	449.72	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.05	(257)
SAP value	85.37	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	5463.42	x	0.216	=	1180.10	(261)
Water heating	1899.82	x	0.216	=	410.36	(264)
Space and water heating				$(261) + (262) + (263) + (264) =$	1590.46	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	482.08	x	0.519	=	250.20	(268)
Total CO ₂ , kg/year				$(265)...(271) =$	1879.58	(272)
Dwelling CO ₂ emission rate				$(272) \div (4) =$	13.92	(273)
EI value					86.01	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5463.42	x	1.22	=	6665.38	(261)

Water heating	1899.82	x	1.22	=	2317.78	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8983.15	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	482.08	x	3.07	=	1479.98	(268)
Primary energy kWh/year					10693.38	(272)
Dwelling primary energy rate kWh/m2/year					79.18	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	H442--H7 Kirkdale (Hipped Roof) Detached Part L2013 Masonry, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	62.46 (1a)	x	2.31 (2a)	=	144.28 (3a)
+1	61.90 (1b)	x	2.56 (2b)	=	158.46 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		124.36 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		302.75 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.13 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.38 (18)
Number of sides on which the dwelling is sheltered			4 (19)
Shelter factor		1 - [0.075 x (19)] =	0.70 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.27 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.30	0.31

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Window			17.32	x	1.24	=	21.40	(27)					
Door			2.38	x	1.10	=	2.62	(26)					
Door			2.00	x	1.50	=	3.00	(26)					
Ground floor			62.46	x	0.14	=	8.74	(28a)					
External wall			132.76	x	0.27	=	35.85	(29a)					
Roof			61.90	x	0.11	=	6.81	(30)					
Roof			0.44	x	0.17	=	0.07	(30)					
Total area of external elements ΣA, m ²			279.26					(31)					
Fabric heat loss, W/K = Σ(A × U)						(26)...(30) + (32) =	78.49	(33)					
Heat capacity Cm = Σ(A × κ)						(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)					
Thermal mass parameter (TMP) in kJ/m ² K							159.82	(35)					
Thermal bridges: Σ(L × Ψ) calculated using Appendix K							8.80	(36)					
Total fabric heat loss						(33) + (36) =	87.29	(37)					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	55.78	55.55	55.33	54.29	54.09	53.19	53.19	53.02	53.54	54.09	54.49	54.90	(38)
Heat transfer coefficient, W/K (37)m + (38)m	143.07	142.84	142.62	141.58	141.38	140.48	140.48	140.31	140.83	141.38	141.78	142.19	
	Average = Σ(39)1...12/12 =											141.58	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.14	1.14	1.14	
	Average = Σ(40)1...12/12 =											1.14	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.88											(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$	102.57											(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$	112.83	108.72	104.62	100.52	96.41	92.31	92.31	96.41	100.52	104.62	108.72	112.83	
	$\Sigma(44)1...12 =$											1230.83	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)	167.32	146.34	151.01	131.65	126.32	109.01	101.01	115.91	117.30	136.70	149.22	162.04	
	$\Sigma(45)1...12 =$											1613.81	(45)
Distribution loss $0.15 \times (45)m$	25.10	21.95	22.65	19.75	18.95	16.35	15.15	17.39	17.59	20.50	22.38	24.31	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel												149.00	(47)
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)												1.16	(48)
Temperature factor from Table 2b												0.54	(49)
Energy lost from water storage (kWh/day) $(48) \times (49)$												0.63	(50)
Enter (50) or (54) in (55)												0.63	(55)
Water storage loss calculated for each month $(55) \times (41)m$													

19.42	17.54	19.42	18.79	19.42	18.79	19.42	19.42	18.79	19.42	18.79	19.42	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

19.42	17.54	19.42	18.79	19.42	18.79	19.42	19.42	18.79	19.42	18.79	19.42	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

210.00	184.89	193.69	172.96	169.00	150.31	143.69	158.59	158.60	179.38	190.52	204.72	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-32.78	-28.85	-29.44	-24.22	-22.48	-18.55	-15.69	-19.00	-19.56	-24.18	-28.01	-31.69	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

177.21	156.04	164.25	148.74	146.52	131.77	128.00	139.59	139.04	155.20	162.50	173.03	
$\Sigma(64)1...12 =$											1821.89	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

89.78	79.50	84.35	76.82	76.15	69.29	67.73	72.69	72.04	79.60	82.66	88.02	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

172.72	172.72	172.72	172.72	172.72	172.72	172.72	172.72	172.72	172.72	172.72	172.72	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

69.61	61.82	50.28	38.06	28.45	24.02	25.96	33.74	45.28	57.50	67.11	71.54	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

434.01	438.51	427.16	403.00	372.50	343.84	324.69	320.19	331.54	355.70	386.19	414.86	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

55.15	55.15	55.15	55.15	55.15	55.15	55.15	55.15	55.15	55.15	55.15	55.15	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	-115.15	(71)
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Water heating gains (Table 5)

120.67	118.30	113.38	106.69	102.35	96.23	91.04	97.70	100.06	106.98	114.80	118.31	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

740.01	734.36	706.55	663.48	619.03	579.82	557.41	567.35	592.61	635.90	683.83	720.44	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	5.05	x	10.63	x 0.9 x	0.71	x	0.70	=	18.49	(74)
NorthWest	0.77	x	0.72	x	11.28	x 0.9 x	0.71	x	0.70	=	2.80	(81)
NorthEast	0.77	x	0.72	x	11.28	x 0.9 x	0.71	x	0.70	=	2.80	(75)
South	0.77	x	9.39	x	46.75	x 0.9 x	0.71	x	0.70	=	151.20	(78)
West	0.77	x	0.72	x	19.64	x 0.9 x	0.71	x	0.70	=	4.87	(80)
East	0.77	x	0.72	x	19.64	x 0.9 x	0.71	x	0.70	=	4.87	(76)

Solar gains in watts $\Sigma(74)m...(82)m$

185.03	313.42	427.40	532.45	602.86	602.36	579.06	525.27	463.23	345.70	221.23	158.65	(83)
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Total gains - internal and solar (73)m + (83)m

925.04	1047.78	1133.95	1195.94	1221.89	1182.18	1136.46	1092.61	1055.83	981.60	905.06	879.09	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.94	0.90	0.81	0.67	0.51	0.55	0.75	0.91	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.43	19.64	19.95	20.32	20.66	20.88	20.96	20.95	20.81	20.39	19.84	19.39	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.97	19.97	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.93	0.87	0.77	0.59	0.41	0.44	0.68	0.88	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.89	18.19	18.63	19.16	19.61	19.88	19.96	19.95	19.80	19.26	18.48	17.82	(90)
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Living area fraction Living area ÷ (4) = 0.21 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.21	18.49	18.90	19.40	19.83	20.09	20.17	20.16	20.02	19.50	18.77	18.15	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.06	18.34	18.75	19.25	19.68	19.94	20.02	20.01	19.87	19.35	18.62	18.00	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.96	0.94	0.91	0.85	0.75	0.58	0.41	0.45	0.67	0.86	0.94	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

890.98	989.61	1035.80	1021.84	916.96	690.14	467.96	489.64	708.58	847.05	853.32	851.20	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1969.19	1920.27	1747.63	1466.03	1127.98	750.40	480.49	506.96	811.95	1236.61	1633.09	1962.72	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

802.19	625.40	529.60	319.82	157.00	0.00	0.00	0.00	0.00	289.83	561.44	826.97	
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Σ(98)1...5, 10...12 = 4112.25 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 33.07 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 90.40 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

887.38	691.82	585.84	353.79	173.68	0.00	0.00	0.00	0.00	320.61	621.06	914.79	
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Σ(211)1...5, 10...12 = 4548.95 (211)

Water heating

Efficiency of water heater

88.26	88.04	87.62	86.70	84.90	79.70	79.70	79.70	79.70	86.36	87.76	88.35	(217)
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Water heating fuel, kWh/month

200.80	177.24	187.46	171.55	172.58	165.33	160.60	175.15	174.46	179.72	185.18	195.85	
$\Sigma(219a)1...12 =$											2145.91	(219)

Annual totals

Space heating fuel - main system 1

4548.95

Water heating fuel

2145.91

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan

45.00

(230e)

Total electricity for the above, kWh/year

75.00

(231)

Electricity for lighting (Appendix L)

491.72

(232)

Total delivered energy for all uses

$(211)...(221) + (231) + (232)...(237b) =$ 7261.58

(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4548.95	x	3.48	x 0.01 =	158.30	(240)
Water heating	2145.91	x	3.48	x 0.01 =	74.68	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	491.72	x	13.19	x 0.01 =	64.86	(250)
Additional standing charges					120.00	(251)
Total energy cost				$(240)...(242) + (245)...(254) =$	427.73	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.06	(257)
SAP value	85.20	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4548.95	x	0.216	=	982.57	(261)
Water heating	2145.91	x	0.216	=	463.52	(264)
Space and water heating				$(261) + (262) + (263) + (264) =$	1446.09	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	491.72	x	0.519	=	255.20	(268)
Total CO ₂ , kg/year				$(265)...(271) =$	1740.22	(272)
Dwelling CO ₂ emission rate				$(272) \div (4) =$	13.99	(273)
EI value					86.23	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4548.95	x	1.22	=	5549.72	(261)

Water heating	2145.91	x	1.22	=	2618.01	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8167.73	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	491.72	x	3.07	=	1509.57	(268)
Primary energy kWh/year					9907.55	(272)
Dwelling primary energy rate kWh/m2/year					79.67	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	H456--X7 Avondale DS07 Detached Part L2013 Masonry, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	68.66 (1a)	x	2.31 (2a)	=	158.60 (3a)
+1	68.13 (1b)	x	2.64 (2b)	=	179.86 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		136.79 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		338.47 (5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
Air changes per hour				
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40		÷ (5) =	0.12 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)				0.37 (18)
Number of sides on which the dwelling is sheltered				4 (19)
Shelter factor	1 - [0.075 x (19)] =		0.70	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.26	(21)
Infiltration rate modified for monthly wind speed:				

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.33	0.32	0.32	0.28	0.28	0.25	0.25	0.24	0.26	0.28	0.29	0.30

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Window			26.36	x 1.24	= 32.57		(27)						
Door			1.97	x 1.50	= 2.96		(26)						
Door			2.38	x 1.10	= 2.62		(26)						
Ground floor			68.66	x 0.14	= 9.61		(28a)						
External wall			153.87	x 0.27	= 41.54		(29a)						
Roof			68.13	x 0.11	= 7.49		(30)						
Roof			0.43	x 0.17	= 0.07		(30)						
Total area of external elements ΣA, m ²			321.80				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	96.87	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						164.28	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						9.54	(36)						
Total fabric heat loss					(33) + (36) =	106.41	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	61.89	61.66	61.43	60.35	60.15	59.20	59.20	59.03	59.57	60.15	60.55	60.98	(38)
Heat transfer coefficient, W/K (37)m + (38)m	168.30	168.07	167.84	166.76	166.56	165.61	165.61	165.44	165.98	166.56	166.97	167.39	
	Average = Σ(39)1...12/12 =											166.76	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.23	1.23	1.23	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.22	1.22	
	Average = Σ(40)1...12/12 =											1.22	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.91	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												103.33	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	113.66	109.53	105.40	101.26	97.13	93.00	93.00	97.13	101.26	105.40	109.53	113.66		
												$\Sigma(44)_{1...12} =$	1239.95	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	168.56	147.42	152.13	132.63	127.26	109.81	101.76	116.77	118.17	137.71	150.32	163.24		
												$\Sigma(45)_{1...12} =$	1625.77	(45)
Distribution loss $0.15 \times (45)_m$														
	25.28	22.11	22.82	19.89	19.09	16.47	15.26	17.52	17.72	20.66	22.55	24.49	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												178.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.27	(48)	
Temperature factor from Table 2b												0.54	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												0.69	(50)	
Enter (50) or (54) in (55)												0.69	(55)	
Water storage loss calculated for each month $(55) \times (41)_m$														

21.26	19.20	21.26	20.57	21.26	20.57	21.26	21.26	20.57	21.26	20.57	21.26	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

21.26	19.20	21.26	20.57	21.26	20.57	21.26	21.26	20.57	21.26	20.57	21.26	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

213.08	187.64	196.65	175.71	171.78	152.90	146.28	161.29	161.25	182.23	193.41	207.76	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-30.84	-27.14	-27.70	-22.78	-21.15	-17.45	-14.76	-17.87	-18.40	-22.75	-26.36	-29.81	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

182.24	160.49	168.95	152.93	150.63	135.45	131.52	143.42	142.85	159.49	167.05	177.95	
$\Sigma(64)1...12 =$											1872.97	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

91.66	81.19	86.20	78.57	77.93	70.98	69.45	74.44	73.76	81.41	84.45	89.89	(65)
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5. Internal gains

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

174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	174.64	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

68.14	60.52	49.22	37.26	27.85	23.52	25.41	33.03	44.33	56.29	65.70	70.03	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

456.32	461.05	449.12	423.72	391.65	361.51	341.38	336.64	348.58	373.98	406.04	436.18	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

55.37	55.37	55.37	55.37	55.37	55.37	55.37	55.37	55.37	55.37	55.37	55.37	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	-116.43	(71)
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Water heating gains (Table 5)

123.20	120.82	115.86	109.12	104.75	98.59	93.35	100.06	102.44	109.42	117.29	120.83	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

764.25	758.98	730.79	686.69	640.84	600.20	576.73	586.32	611.94	656.27	705.62	743.63	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	1.00	x	7.26	x	46.75	x 0.9 x	0.71	x	0.70	=	151.82	(78)
North	1.00	x	8.61	x	10.63	x 0.9 x	0.71	x	0.70	=	40.95	(74)
SouthEast	1.00	x	0.68	x	36.79	x 0.9 x	0.71	x	0.70	=	11.19	(77)
SouthWest	1.00	x	0.68	x	36.79	x 0.9 x	0.71	x	0.70	=	11.19	(79)
West	1.00	x	4.60	x	19.64	x 0.9 x	0.71	x	0.70	=	40.41	(80)
East	1.00	x	4.53	x	19.64	x 0.9 x	0.71	x	0.70	=	39.80	(76)

Solar gains in watts $\Sigma(74)m...(82)m$

295.37	521.94	760.28	1013.08	1195.03	1211.70	1157.76	1018.95	847.77	589.66	357.30	250.44	(83)
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Total gains - internal and solar (73)m + (83)m

1059.61	1280.92	1491.07	1699.77	1835.87	1811.90	1734.49	1605.27	1459.70	1245.94	1062.92	994.07	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.96	0.92	0.84	0.71	0.54	0.41	0.46	0.68	0.89	0.96	0.98	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.36	19.64	20.02	20.45	20.77	20.93	20.98	20.97	20.85	20.42	19.80	19.30	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.90	19.90	19.90	19.90	19.91	19.91	19.91	19.91	19.91	19.91	19.90	19.90	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.95	0.90	0.81	0.65	0.46	0.31	0.36	0.60	0.85	0.95	0.98	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.74	18.13	18.68	19.27	19.68	19.86	19.90	19.90	19.79	19.25	18.38	17.66	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction Living area ÷ (4) = 0.18 (91)

Mean internal temperature for the whole dwelling $fLA \times T1 + (1 - fLA) \times T2$

18.03	18.40	18.92	19.48	19.87	20.05	20.09	20.09	19.98	19.45	18.63	17.95	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.88	18.25	18.77	19.33	19.72	19.90	19.94	19.94	19.83	19.30	18.48	17.80	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, η_m

0.96	0.93	0.88	0.79	0.64	0.46	0.32	0.36	0.59	0.83	0.94	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $\eta_m G_m$, W (94)m x (84)m

1018.93	1195.70	1316.04	1336.98	1178.64	841.09	547.01	574.70	864.38	1037.34	996.49	962.14	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
------	------	------	------	-------	-------	-------	-------	-------	-------	------	------	------

Heat loss rate for mean internal temperature, L_m , W [(39)m x [(93)m - (96)m]

2285.62	2244.07	2059.06	1740.02	1335.90	878.02	553.89	585.55	950.46	1449.87	1900.60	2276.79	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)m - (95)m] \times (41)m$

942.42	704.50	552.81	290.19	117.00	0.00	0.00	0.00	0.00	306.92	650.96	978.10	
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$\Sigma(98)1...5, 10...12 = 4542.90$ (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 33.21 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 90.60 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

1040.20	777.60	610.16	320.30	129.14	0.00	0.00	0.00	0.00	338.76	718.50	1079.58	
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$\Sigma(211)1...5, 10...12 = 5014.24$ (211)

Water heating

Efficiency of water heater

88.68	88.40	87.85	86.60	84.25	79.90	79.90	79.90	79.90	86.63	88.19	88.77	(217)
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Water heating fuel, kWh/month

205.51	181.55	192.32	176.60	178.79	169.53	164.61	179.50	178.79	184.09	189.43	200.46	
$\Sigma(219a)1...12 =$											2201.17	(219)

Annual totals

Space heating fuel - main system 1

5014.24

Water heating fuel

2201.17

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan

45.00

(230e)

Total electricity for the above, kWh/year

75.00

(231)

Electricity for lighting (Appendix L)

481.35

(232)

Total delivered energy for all uses

$(211)...(221) + (231) + (232)...(237b) =$ 7771.76

(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5014.24	x	3.48	x 0.01 =	174.50	(240)
Water heating	2201.17	x	3.48	x 0.01 =	76.60	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	481.35	x	13.19	x 0.01 =	63.49	(250)
Additional standing charges					120.00	(251)
Total energy cost				$(240)...(242) + (245)...(254) =$	444.48	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.03	(257)
SAP value	85.67	
SAP rating (section 13)	86	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	5014.24	x	0.216	=	1083.08	(261)
Water heating	2201.17	x	0.216	=	475.45	(264)
Space and water heating				$(261) + (262) + (263) + (264) =$	1558.53	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	481.35	x	0.519	=	249.82	(268)
Total CO ₂ , kg/year				$(265)...(271) =$	1847.28	(272)
Dwelling CO ₂ emission rate				$(272) \div (4) =$	13.50	(273)
EI value					86.38	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5014.24	x	1.22	=	6117.37	(261)

Water heating	2201.17	x	1.22	=	2685.43	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8802.80	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	481.35	x	3.07	=	1477.75	(268)
Primary energy kWh/year					10510.80	(272)
Dwelling primary energy rate kWh/m2/year					76.84	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	H469-X7 (Holden) Detached H-Range, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	73.85 (1a)	x	2.33 (2a)	=	172.07 (3a)
+1	69.16 (1b)	x	2.56 (2b)	=	177.05 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		143.01 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		349.12 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.11 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.31 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.32	1.50	6.48		(26)
Window			26.85	1.24	33.18		(27)
Ground floor			73.85	0.14	10.34		(28a)
External wall			140.83	0.27	38.02		(29a)
Roof			69.16	0.11	7.61		(30)
Roof			4.68	0.17	0.80		(30)
Total area of external elements $\sum A$, m ²			319.69				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	96.43	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						194.50	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						9.71	(36)
Total fabric heat loss					(33) + (36) =	106.13	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
66.62	66.27	65.93	64.32	64.02	62.61	62.61	62.35	63.15	64.02	64.63	65.26	(38)

Heat transfer coefficient, W/K (37)m + (38)m	172.75	172.40	172.06	170.45	170.15	168.74	168.74	168.48	169.28	170.15	170.76	171.40	
Average = $\sum(39)1...12/12 =$	170.45												(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.21	1.21	1.20	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.20	
Average = $\sum(40)1...12/12 =$	1.19												(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.92												(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	103.61												(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
113.97	109.83	105.68	101.54	97.40	93.25	93.25	97.40	101.54	105.68	109.83	113.97		
											$\Sigma(44)1...12 =$	1243.34	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	169.02	147.82	152.54	132.99	127.61	110.12	102.04	117.09	118.49	138.09	150.73	163.69	
$\sum(45)1...12 =$	1630.22												(45)

Distribution loss 0.15 x (45)m	25.35	22.17	22.88	19.95	19.14	16.52	15.31	17.56	17.77	20.71	22.61	24.55	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	210.00												(47)

Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)	1.48												(48)
Temperature factor from Table 2b	0.54												(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.80												(50)
Enter (50) or (54) in (55)	0.80												(55)

Water storage loss calculated for each month (55) x (41)m	24.78	22.38	24.78	23.98	24.78	23.98	24.78	24.78	23.98	24.78	23.98	24.78	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

24.78	22.38	24.78	23.98	24.78	23.98	24.78	24.78	23.98	24.78	23.98	24.78	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

217.06	191.21	200.58	179.48	175.64	156.60	150.08	165.13	164.98	186.12	197.22	211.72	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-30.95	-27.24	-27.80	-22.86	-21.23	-17.51	-14.81	-17.94	-18.46	-22.83	-26.45	-29.92	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

186.10	163.98	172.78	156.61	154.42	139.10	135.26	147.19	146.51	163.30	170.77	181.80	
$\Sigma(64)1...12 =$											1917.82	(64)

Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

94.63	83.86	89.15	81.41	80.86	73.80	72.36	77.36	76.59	84.34	87.31	92.86	(65)
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5. Internal gains

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

175.36	175.36	175.36	175.36	175.36	175.36	175.36	175.36	175.36	175.36	175.36	175.36	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

70.76	62.85	51.11	38.69	28.92	24.42	26.39	34.30	46.03	58.45	68.22	72.72	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

466.88	471.72	459.52	433.52	400.72	369.88	349.28	344.44	356.64	382.64	415.44	446.28	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	55.46	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	-116.90	(71)
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Water heating gains (Table 5)

127.19	124.80	119.83	113.07	108.68	102.51	97.25	103.98	106.37	113.37	121.26	124.81	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

781.74	776.28	747.36	702.20	655.23	613.71	589.83	599.62	625.96	671.36	721.84	760.72	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	13.24	x	11.28	x 0.9 x	0.71	x	0.70	=	51.45	(81)
SouthWest	0.77	x	1.97	x	36.79	x 0.9 x	0.71	x	0.70	=	24.96	(79)
NorthEast	0.77	x	3.29	x	11.28	x 0.9 x	0.71	x	0.70	=	12.79	(75)
SouthEast	0.77	x	6.61	x	36.79	x 0.9 x	0.71	x	0.70	=	83.77	(77)
South	0.77	x	0.87	x	46.75	x 0.9 x	0.71	x	0.70	=	14.01	(78)
East	0.77	x	0.87	x	19.64	x 0.9 x	0.71	x	0.70	=	5.89	(76)

Solar gains in watts $\Sigma(74)m...(82)m$

192.86	350.42	537.18	761.56	940.06	971.40	920.67	781.77	614.03	402.90	235.00	162.45	(83)
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Total gains - internal and solar (73)m + (83)m

974.60	1126.70	1284.54	1463.76	1595.29	1585.12	1510.50	1381.40	1239.99	1074.26	956.84	923.17	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area n1,m (see Table 9a)												(86)
	0.99	0.98	0.96	0.91	0.80	0.63	0.48	0.54	0.78	0.94	0.98	0.99
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												(87)
	19.49	19.69	20.01	20.42	20.76	20.93	20.98	20.97	20.84	20.40	19.87	19.45
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)												(88)
	19.91	19.92	19.92	19.93	19.93	19.94	19.94	19.94	19.93	19.93	19.92	19.92
Utilisation factor for gains for rest of dwelling n2,m												(89)
	0.99	0.98	0.95	0.89	0.75	0.54	0.37	0.42	0.70	0.92	0.98	0.99
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												(90)
	17.92	18.20	18.67	19.25	19.68	19.89	19.93	19.92	19.80	19.24	18.48	17.87
Living area fraction	Living area ÷ (4) =										0.15	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												(92)
	18.15	18.42	18.87	19.43	19.84	20.04	20.08	20.08	19.95	19.41	18.68	18.10
Apply adjustment to the mean internal temperature from Table 4e where appropriate												(93)
	18.00	18.27	18.72	19.28	19.69	19.89	19.93	19.93	19.80	19.26	18.53	17.95

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm												(94)
	0.98	0.97	0.94	0.87	0.73	0.54	0.37	0.42	0.69	0.90	0.97	0.99
Useful gains, ηmGm, W (94)m x (84)m												(95)
	957.64	1092.59	1208.15	1271.60	1168.79	852.70	556.16	583.40	856.84	971.82	928.22	909.90
Monthly average external temperature from Table U1												(96)
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												(97)
	2366.65	2305.57	2102.28	1768.84	1360.01	893.03	562.65	594.64	965.11	1473.51	1952.34	2356.95
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												(98)
	1048.31	815.12	665.23	358.01	142.27	0.00	0.00	0.00	0.00	373.26	737.36	1076.60
	Σ(98)1...5, 10...12 =										5216.16	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)										36.47	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating												
Fraction of space heat from secondary/supplementary system (table 11)												(201)
											0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =										1.00	(202)
Fraction of space heat from main system 2											0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] =										1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =										0.00	(205)
Efficiency of main system 1 (%)											90.60	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												(211)
	1157.07	899.69	734.25	395.16	157.03	0.00	0.00	0.00	0.00	411.98	813.87	1188.30
	Σ(211)1...5, 10...12 =										5757.35	(211)

Water heating

Efficiency of water heater

88.81	88.61	88.17	87.05	84.70	79.90	79.90	79.90	79.90	87.05	88.37	88.88	(217)
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Water heating fuel, kWh/month

209.56	185.05	195.97	179.91	182.32	174.09	169.29	184.22	183.37	187.58	193.23	204.55	
$\Sigma(219a)1...12 =$											2249.14	(219)

Annual totals

Space heating fuel - main system 1											5757.35	
Water heating fuel											2249.14	
Electricity for pumps, fans and electric keep-hot (Table 4f)												
central heating pump or water pump within warm air heating unit							30.00					(230c)
boiler flue fan							45.00					(230e)
Total electricity for the above, kWh/year											75.00	(231)
Electricity for lighting (Appendix L)											499.84	(232)
Total delivered energy for all uses											(211)...(221) + (231) + (232)...(237b) =	8581.33 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5757.35	x	3.48	x 0.01 =	200.36	(240)
Water heating	2249.14	x	3.48	x 0.01 =	78.27	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	499.84	x	13.19	x 0.01 =	65.93	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	474.45	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)		1.06	(257)
SAP value		85.21	
SAP rating (section 13)		85	(258)
SAP band		B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	5757.35	x	0.216	=	1243.59	(261)
Water heating	2249.14	x	0.216	=	485.81	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1729.40	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	499.84	x	0.519	=	259.42	(268)
Total CO ₂ , kg/year				(265)...(271) =	2027.74	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	14.18	(273)
EI value					85.55	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5757.35	x	1.22	=	7023.97	(261)
Water heating	2249.14	x	1.22	=	2743.95	(264)

Space and water heating				(261) + (262) + (263) + (264) =	9767.92	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	499.84	x	3.07	=	1534.50	(268)
Primary energy kWh/year					11532.67	(272)
Dwelling primary energy rate kWh/m2/year					80.64	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	H486---7 (Hollinwood) Detached, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	58.21 (1a)	x	2.33 (2a)	=	135.63 (3a)
+1	55.26 (1b)	x	2.56 (2b)	=	141.47 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				113.47 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				277.09 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	5	x 10 =	50 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 50	÷ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.43 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor	1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.37 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.47	0.46	0.45	0.40	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.12	1.10	2.33		(26)						
Window			24.66	1.24	30.47		(27)						
Door			1.97	1.50	2.96		(26)						
Ground floor			58.26	0.14	8.16		(28a)						
External wall			131.25	0.27	35.44		(29a)						
Roof			55.26	0.11	6.08		(30)						
Roof			2.95	0.17	0.50		(30)						
Total area of external elements ΣA, m ²			276.47				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	85.93	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						171.72	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						8.79	(36)						
Total fabric heat loss					(33) + (36) =	94.72	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	55.69	55.31	54.93	53.14	52.81	51.26	51.26	50.97	51.86	52.81	53.48	54.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	150.42	150.03	149.65	147.87	147.54	145.98	145.98	145.69	146.58	147.54	148.21	148.92	
	Average = Σ(39)1...12/12 =											147.87	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.33	1.32	1.32	1.30	1.30	1.29	1.29	1.28	1.29	1.30	1.31	1.31	
	Average = Σ(40)1...12/12 =											1.30	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.83	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												101.51	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	111.66	107.60	103.54	99.48	95.42	91.36	91.36	95.42	99.48	103.54	107.60	111.66		
												$\Sigma(44)_{1...12} =$	1218.13	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	165.59	144.83	149.45	130.29	125.02	107.88	99.97	114.72	116.09	135.29	147.68	160.37		
												$\Sigma(45)_{1...12} =$	1597.16	(45)
Distribution loss $0.15 \times (45)m$														
	24.84	21.72	22.42	19.54	18.75	16.18	15.00	17.21	17.41	20.29	22.15	24.05	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												150.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												0.96	(48)	
Temperature factor from Table 2b												0.54	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												0.52	(50)	
Enter (50) or (54) in (55)												0.52	(55)	
Water storage loss calculated for each month $(55) \times (41)m$														

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

204.92	180.35	188.78	168.36	164.35	145.95	139.30	154.05	154.15	174.62	185.74	199.70	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-30.14	-26.52	-27.06	-22.26	-20.67	-17.05	-14.43	-17.47	-17.98	-22.23	-25.75	-29.13	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

174.79	153.84	161.72	146.09	143.68	128.90	124.87	136.58	136.17	152.39	159.99	170.57	
$\Sigma(64)1...12 =$											1789.58	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

86.53	76.58	81.16	73.77	73.04	66.32	64.71	69.61	69.05	76.45	79.55	84.79	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

61.66	54.77	44.54	33.72	25.21	21.28	22.99	29.89	40.12	50.94	59.45	63.38	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

412.61	416.89	406.10	383.13	354.14	326.89	308.68	304.40	315.19	338.16	367.16	394.41	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	(71)
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Water heating gains (Table 5)

116.30	113.95	109.08	102.46	98.17	92.11	86.97	93.56	95.90	102.75	110.49	113.96	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

705.09	700.14	674.25	633.84	592.03	554.80	533.17	542.37	565.73	606.37	651.62	686.27	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	8.60	x	11.28	x 0.9 x	0.71	x	0.70	=	33.42	(81)
NorthEast	0.77	x	4.49	x	11.28	x 0.9 x	0.71	x	0.70	=	17.45	(75)
SouthWest	0.77	x	9.02	x	36.79	x 0.9 x	0.71	x	0.70	=	114.31	(79)
SouthEast	0.77	x	2.55	x	36.79	x 0.9 x	0.71	x	0.70	=	32.32	(77)

Solar gains in watts $\Sigma(74)m...(82)m$

197.49	353.30	528.28	729.78	886.08	909.88	864.65	743.43	597.33	402.57	239.63	167.02	(83)
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Total gains - internal and solar (73)m + (83)m

902.59	1053.43	1202.53	1363.62	1478.12	1464.68	1397.82	1285.80	1163.06	1008.94	891.24	853.29	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.94	0.87	0.75	0.58	0.44	0.49	0.72	0.90	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.28	19.52	19.90	20.36	20.71	20.91	20.97	20.96	20.81	20.34	19.73	19.24	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.82	19.82	19.83	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.84	19.83	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.92	0.84	0.69	0.50	0.33	0.38	0.64	0.88	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.57	17.92	18.45	19.10	19.56	19.79	19.84	19.83	19.69	19.09	18.23	17.52	(90)
Living area fraction	Living area ÷ (4) =											0.19	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.91	18.23	18.73	19.34	19.78	20.01	20.06	20.05	19.91	19.34	18.52	17.85	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.76	18.08	18.58	19.19	19.63	19.86	19.91	19.90	19.76	19.19	18.37	17.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.94	0.90	0.82	0.68	0.50	0.34	0.39	0.63	0.85	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	869.50	991.96	1082.51	1111.70	1001.45	726.33	475.26	497.90	734.76	861.63	840.06	826.57	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(93)m x [(93)m - (96)m]	2023.98	1977.80	1808.33	1521.73	1170.16	767.33	483.24	510.51	829.64	1266.74	1670.76	2010.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	858.93	662.49	540.01	295.22	125.52	0.00	0.00	0.00	0.00	301.40	598.11	881.06	
	Σ(98)1...5, 10...12 =											4262.74	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)											37.57	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating													
Fraction of space heat from secondary/supplementary system (table 11)											0.00	(201)	
Fraction of space heat from main system(s)											1 - (201) =	1.00	(202)
Fraction of space heat from main system 2											0.00	(202)	
Fraction of total space heat from main system 1											(202) x [1 - (203)] =	1.00	(204)
Fraction of total space heat from main system 2											(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)											90.30	(206)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	951.20	733.65	598.02	326.93	139.00	0.00	0.00	0.00	0.00	333.78	662.36	975.71	
											Σ(211)1...5, 10...12 =	4720.64	(211)

Water heating

Efficiency of water heater

88.29	88.07	87.59	86.45	84.25	79.60	79.60	79.60	79.60	86.40	87.81	88.37	(217)
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Water heating fuel, kWh/month

197.96	174.68	184.64	168.99	170.53	161.93	156.88	171.58	171.07	176.38	182.20	193.01	
$\Sigma(219a)1...12 =$											2109.83	(219)

Annual totals

Space heating fuel - main system 1											4720.64	
Water heating fuel											2109.83	
Electricity for pumps, fans and electric keep-hot (Table 4f)												
central heating pump or water pump within warm air heating unit								30.00				(230c)
boiler flue fan								45.00				(230e)
Total electricity for the above, kWh/year											75.00	(231)
Electricity for lighting (Appendix L)											435.60	(232)
Total delivered energy for all uses											$(211)...(221) + (231) + (232)...(237b) =$	7341.07 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4720.64	x	3.48	x 0.01 =	164.28	(240)
Water heating	2109.83	x	3.48	x 0.01 =	73.42	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	435.60	x	13.19	x 0.01 =	57.46	(250)
Additional standing charges					120.00	(251)
Total energy cost				$(240)...(242) + (245)...(254) =$	425.05	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.13	(257)
SAP value					84.28	
SAP rating (section 13)					84	(258)
SAP band					B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4720.64	x	0.216	=	1019.66	(261)
Water heating	2109.83	x	0.216	=	455.72	(264)
Space and water heating				$(261) + (262) + (263) + (264) =$	1475.38	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	435.60	x	0.519	=	226.08	(268)
Total CO ₂ , kg/year				$(265)...(271) =$	1740.38	(272)
Dwelling CO ₂ emission rate				$(272) \div (4) =$	15.34	(273)
EI value					85.28	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4720.64	x	1.22	=	5759.18	(261)
Water heating	2109.83	x	1.22	=	2573.99	(264)

Space and water heating			(261) + (262) + (263) + (264) =	8333.18	(265)
Pumps and fans	75.00	x	3.07	=	230.25 (267)
Electricity for lighting	435.60	x	3.07	=	1337.29 (268)
Primary energy kWh/year					9900.72 (272)
Dwelling primary energy rate kWh/m2/year					87.25 (273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	H486---7 (Hollinwood) Detached, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	58.21 (1a)	x	2.33 (2a)	=	135.63 (3a)
+1	55.26 (1b)	x	2.56 (2b)	=	141.47 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		113.47 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		277.09 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	5	x 10 =	50 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 50	÷ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.43 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.37 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.47	0.46	0.45	0.40	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.12	1.10	2.33		(26)						
Window			24.66	1.24	30.47		(27)						
Door			1.97	1.50	2.96		(26)						
Ground floor			58.26	0.14	8.16		(28a)						
External wall			131.25	0.27	35.44		(29a)						
Roof			55.26	0.11	6.08		(30)						
Roof			2.95	0.17	0.50		(30)						
Total area of external elements ΣA, m ²			276.47				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	85.93	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						171.72	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						8.79	(36)						
Total fabric heat loss					(33) + (36) =	94.72	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	55.69	55.31	54.93	53.14	52.81	51.26	51.26	50.97	51.86	52.81	53.48	54.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	150.42	150.03	149.65	147.87	147.54	145.98	145.98	145.69	146.58	147.54	148.21	148.92	
	Average = Σ(39)1...12/12 =											147.87	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.33	1.32	1.32	1.30	1.30	1.29	1.29	1.28	1.29	1.30	1.31	1.31	
	Average = Σ(40)1...12/12 =											1.30	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.83	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												101.51	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	111.66	107.60	103.54	99.48	95.42	91.36	91.36	95.42	99.48	103.54	107.60	111.66		
												$\Sigma(44)1...12 =$	1218.13	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	165.59	144.83	149.45	130.29	125.02	107.88	99.97	114.72	116.09	135.29	147.68	160.37		
												$\Sigma(45)1...12 =$	1597.16	(45)
Distribution loss $0.15 \times (45)m$														
	24.84	21.72	22.42	19.54	18.75	16.18	15.00	17.21	17.41	20.29	22.15	24.05	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												150.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												0.96	(48)	
Temperature factor from Table 2b												0.54	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												0.52	(50)	
Enter (50) or (54) in (55)												0.52	(55)	
Water storage loss calculated for each month $(55) \times (41)m$														

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

16.07	14.52	16.07	15.55	16.07	15.55	16.07	16.07	15.55	16.07	15.55	16.07	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

204.92	180.35	188.78	168.36	164.35	145.95	139.30	154.05	154.15	174.62	185.74	199.70	(62)
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Solar DHW input calculated using Appendix G or Appendix H

-30.14	-26.52	-27.06	-22.26	-20.67	-17.05	-14.43	-17.47	-17.98	-22.23	-25.75	-29.13	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

174.79	153.84	161.72	146.09	143.68	128.90	124.87	136.58	136.17	152.39	159.99	170.57	
$\Sigma(64)1...12 =$											1789.58	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

86.53	76.58	81.16	73.77	73.04	66.32	64.71	69.61	69.05	76.45	79.55	84.79	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	170.05	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

61.66	54.77	44.54	33.72	25.21	21.28	22.99	29.89	40.12	50.94	59.45	63.38	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

412.61	416.89	406.10	383.13	354.14	326.89	308.68	304.40	315.19	338.16	367.16	394.41	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	54.84	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	-113.37	(71)
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Water heating gains (Table 5)

116.30	113.95	109.08	102.46	98.17	92.11	86.97	93.56	95.90	102.75	110.49	113.96	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

705.09	700.14	674.25	633.84	592.03	554.80	533.17	542.37	565.73	606.37	651.62	686.27	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	8.60	x	11.28	x 0.9 x	0.71	x	0.70	=	33.42	(81)
NorthEast	0.77	x	4.49	x	11.28	x 0.9 x	0.71	x	0.70	=	17.45	(75)
SouthWest	0.77	x	9.02	x	36.79	x 0.9 x	0.71	x	0.70	=	114.31	(79)
SouthEast	0.77	x	2.55	x	36.79	x 0.9 x	0.71	x	0.70	=	32.32	(77)

Solar gains in watts $\Sigma(74)m...(82)m$

197.49	353.30	528.28	729.78	886.08	909.88	864.65	743.43	597.33	402.57	239.63	167.02	(83)
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Total gains - internal and solar (73)m + (83)m

902.59	1053.43	1202.53	1363.62	1478.12	1464.68	1397.82	1285.80	1163.06	1008.94	891.24	853.29	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.94	0.87	0.75	0.58	0.44	0.49	0.72	0.90	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.28	19.52	19.90	20.36	20.71	20.91	20.97	20.96	20.81	20.34	19.73	19.24	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.82	19.82	19.83	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.84	19.83	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.92	0.84	0.69	0.50	0.33	0.38	0.64	0.88	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.57	17.92	18.45	19.10	19.56	19.79	19.84	19.83	19.69	19.09	18.23	17.52	(90)
Living area fraction	Living area ÷ (4) =											0.19	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.91	18.23	18.73	19.34	19.78	20.01	20.06	20.05	19.91	19.34	18.52	17.85	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.76	18.08	18.58	19.19	19.63	19.86	19.91	19.90	19.76	19.19	18.37	17.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.94	0.90	0.82	0.68	0.50	0.34	0.39	0.63	0.85	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	869.50	991.96	1082.51	1111.70	1001.45	726.33	475.26	497.90	734.76	861.63	840.06	826.57	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(93)m x [(93)m - (96)m]	2023.98	1977.80	1808.33	1521.73	1170.16	767.33	483.24	510.51	829.64	1266.74	1670.76	2010.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	858.93	662.49	540.01	295.22	125.52	0.00	0.00	0.00	0.00	301.40	598.11	881.06	
	Σ(98)1...5, 10...12 =											4262.74	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)											37.57	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating													
Fraction of space heat from secondary/supplementary system (table 11)											0.00	(201)	
Fraction of space heat from main system(s)											1 - (201) =	1.00	(202)
Fraction of space heat from main system 2											0.00	(202)	
Fraction of total space heat from main system 1											(202) x [1 - (203)] =	1.00	(204)
Fraction of total space heat from main system 2											(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)											90.30	(206)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	951.20	733.65	598.02	326.93	139.00	0.00	0.00	0.00	0.00	333.78	662.36	975.71	
											Σ(211)1...5, 10...12 =	4720.64	(211)

Water heating

Efficiency of water heater

88.29	88.07	87.59	86.45	84.25	79.60	79.60	79.60	79.60	86.40	87.81	88.37	(217)
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Water heating fuel, kWh/month

197.96	174.68	184.64	168.99	170.53	161.93	156.88	171.58	171.07	176.38	182.20	193.01	
$\Sigma(219a)1...12 =$											2109.83	(219)

Annual totals

Space heating fuel - main system 1												4720.64	
Water heating fuel												2109.83	
Electricity for pumps, fans and electric keep-hot (Table 4f)													
central heating pump or water pump within warm air heating unit										30.00			(230c)
boiler flue fan										45.00			(230e)
Total electricity for the above, kWh/year												75.00	(231)
Electricity for lighting (Appendix L)												435.60	(232)
Energy saving/generation technologies													
electricity generated by PV (Appendix M)												-4337.26	(233)
Total delivered energy for all uses											(211)...(221) + (231) + (232)...(237b) =	3003.81	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4720.64	x	3.48	x 0.01 =	164.28	(240)
Water heating	2109.83	x	3.48	x 0.01 =	73.42	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	435.60	x	13.19	x 0.01 =	57.46	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-4337.26	x	13.19	x 0.01 =	-572.09	(252)
Total energy cost				(240)...(242) + (245)...(254) =	-147.04	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)		-0.39	(257)
SAP value		105.44	
SAP rating (section 13)		105	(258)
SAP band		A	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4720.64	x	0.216	=	1019.66	(261)
Water heating	2109.83	x	0.216	=	455.72	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1475.38	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	435.60	x	0.519	=	226.08	(268)
Energy saving/generation technologies						
pv savings	-4337.26	x	0.519	=	-2251.04	(269)
Total CO ₂ , kg/year				(265)...(271) =	-510.66	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	-4.50	(273)
EI value					104.32	
EI rating (section 14)					104	(274)

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4720.64	x	1.22	=	5759.18	(261)
Water heating	2109.83	x	1.22	=	2573.99	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8333.18	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	435.60	x	3.07	=	1337.29	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-4337.26	x	3.07	=	-13315.40	(269)
Primary energy kWh/year					-3414.68	(272)
Dwelling primary energy rate kWh/m2/year					-30.09	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BKNL 00HE Kenley DS01 (Hipped) EOT BKNL 00HE, Part L2013 Masonry		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	28.99 (1a)	x	2.33 (2a)	=	67.55 (3a)
+1	28.99 (1b)	x	2.56 (2b)	=	74.21 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		57.98 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		141.76 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	2	x 10 =	20 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20	÷ (5) =	0.14 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.39 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor	1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.33 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.42	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.56	0.56	0.57	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			10.76	1.24	13.30		(27)
Ground floor			28.99	0.14	4.06		(28a)
External wall			61.74	0.27	16.67		(29a)
Party wall			35.46	0.00	0.00		(32)
Roof			28.99	0.11	3.19		(30)
Total area of external elements $\sum A$, m ²			132.45				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	39.18	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						205.27	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						5.71	(36)
Total fabric heat loss					(33) + (36) =	44.89	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
27.60	27.44	27.28	26.53	26.39	25.73	25.73	25.61	25.98	26.39	26.67	26.97	(38)

Heat transfer coefficient, W/K (37)m + (38)m											
72.49	72.33	72.17	71.42	71.28	70.62	70.62	70.50	70.87	71.28	71.56	71.86
Average = $\sum(39)1...12/12 =$										71.42	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)											
1.25	1.25	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24
Average = $\sum(40)1...12/12 =$										1.23	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.92	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.89	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
87.88	84.69	81.49	78.30	75.10	71.91	71.91	75.10	78.30	81.49	84.69	87.88
$\sum(44)1...12 =$										958.74	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)											
130.33	113.99	117.62	102.55	98.40	84.91	78.68	90.29	91.37	106.48	116.23	126.22
$\sum(45)1...12 =$										1257.05	(45)

Distribution loss 0.15 x (45)m												
19.55	17.10	17.64	15.38	14.76	12.74	11.80	13.54	13.70	15.97	17.43	18.93	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.03	12.66	13.99	13.51	13.93	13.46	13.89	13.92	13.48	13.96	13.55	14.02	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

144.36	126.64	131.61	116.05	112.33	98.37	92.57	104.21	104.85	120.44	129.78	140.24	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

144.36	126.64	131.61	116.05	112.33	98.37	92.57	104.21	104.85	120.44	129.78	140.24	
$\Sigma(64)1...12 =$											1421.46	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

46.84	41.06	42.61	37.47	36.20	31.60	29.63	33.50	33.75	38.90	42.03	45.47	(65)
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5 Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
115.44	115.44	115.44	115.44	115.44	115.44	115.44	115.44	115.44	115.44	115.44	115.44	(66)

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

38.03	33.77	27.47	20.79	15.54	13.12	14.18	18.43	24.74	31.41	36.66	39.08	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

250.49	253.08	246.53	232.59	214.99	198.44	187.39	184.79	191.34	205.29	222.89	239.43	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.47	48.47	48.47	48.47	48.47	48.47	48.47	48.47	48.47	48.47	48.47	48.47	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	-76.96	(71)
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Water heating gains (Table 5)

62.96	61.11	57.27	52.05	48.66	43.88	39.83	45.03	46.88	52.28	58.38	61.12	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

441.42	437.91	421.22	395.38	369.14	345.40	331.35	338.20	352.90	378.92	407.88	429.58	(73)
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6 Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
NorthEast	0.77	x 6.14	x 11.28	x 0.9 x 0.71	x 0.70	= 23.86	(75)
SouthWest	0.77	x 3.30	x 36.79	x 0.9 x 0.71	x 0.70	= 41.82	(79)
NorthWest	0.77	x 1.32	x 11.28	x 0.9 x 0.71	x 0.70	= 5.13	(81)

Solar gains in watts $\Sigma(74)m...(82)m$

70.81	130.24	203.78	295.37	369.97	384.51	363.54	305.26	235.08	150.84	86.57	59.46	(83)
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Total gains - internal and solar (73)m + (83)m

512.23	568.16	625.00	690.75	739.11	729.91	694.89	643.45	587.99	529.77	494.45	489.05	(84)
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7 Mean internal temperature (heating season)

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

21.00	(85)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.98	0.97	0.95	0.88	0.76	0.58	0.44	0.49	0.72	0.91	0.97	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.69	19.87	20.16	20.53	20.81	20.95	20.99	20.98	20.88	20.52	20.05	19.66	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.88	19.88	19.88	19.89	19.90	19.91	19.91	19.91	19.90	19.90	19.89	19.89	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.93	0.85	0.70	0.50	0.33	0.38	0.64	0.88	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.18	18.43	18.85	19.36	19.71	19.87	19.90	19.90	19.81	19.37	18.70	18.13	(90)
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Living area fraction

Living area ÷ (4) = 0.24 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.54	18.77	19.16	19.64	19.97	20.13	20.16	20.16	20.06	19.64	19.02	18.49	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.39	18.62	19.01	19.49	19.82	19.98	20.01	20.01	19.91	19.49	18.87	18.34	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.95	0.92	0.84	0.70	0.50	0.34	0.39	0.64	0.87	0.95	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

496.01	541.13	573.67	578.78	514.15	367.07	238.76	250.89	377.95	459.99	469.53	475.77	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1021.31	992.54	902.68	756.07	579.10	379.87	240.77	254.25	412.11	633.66	842.12	1016.40	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

390.82	303.34	244.78	127.65	48.32	0.00	0.00	0.00	0.00	129.21	268.27	402.23	
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Σ(98)1...5, 10...12 = 1914.63 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 33.02 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

431.85	335.19	270.48	141.05	53.39	0.00	0.00	0.00	0.00	142.77	296.43	444.45	
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Σ(211)1...5, 10...12 = 2115.61 (211)

Water heating

Efficiency of water heater

89.61	89.53	89.35	88.95	88.24	87.30	87.30	87.30	87.30	88.93	89.43	89.65	(217)
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Water heating fuel, kWh/month

161.09	141.45	147.29	130.47	127.30	112.68	106.04	119.37	120.10	135.44	145.11	156.43	
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Σ(219a)1...12 = 1602.78 (219)

Annual totals

Space heating fuel - main system 1

2115.61

Water heating fuel

1602.78

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	268.61	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4062.01	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2115.61	x	3.48	x 0.01 =	73.62	(240)
Water heating	1602.78	x	3.48	x 0.01 =	55.78	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	268.61	x	13.19	x 0.01 =	35.43	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	294.72	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.20	(257)
SAP value	83.23	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2115.61	x	0.216	=	456.97	(261)
Water heating	1602.78	x	0.216	=	346.20	(264)
Space and water heating			(261) + (262) + (263) + (264) =		803.17	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	268.61	x	0.519	=	139.41	(268)
Total CO ₂ , kg/year				(265)...(271) =	981.51	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	16.93	(273)
EI value					87.23	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2115.61	x	1.22	=	2581.05	(261)
Water heating	1602.78	x	1.22	=	1955.39	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4536.44	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	268.61	x	3.07	=	824.65	(268)
Primary energy kWh/year					5591.34	(272)
Dwelling primary energy rate kWh/m ² /year					96.44	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	21/10/2021
Address	BMAI 00CE DS06 Maidstone EOT, Part L 2013 Masonry, Barratt Developments		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.55 (1a)	x	2.33 (2a)	=	89.82 (3a)
+1	38.55 (1b)	x	2.56 (2b)	=	98.69 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		77.10 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		188.51 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.16 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.41 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.35 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			12.00	1.24	14.83		(27)
Ground floor			38.55	0.14	5.40		(28a)
External wall			71.96	0.27	19.43		(29a)
Party wall			40.52	0.00	0.00		(32)
Roof			38.55	0.11	4.24		(30)
Total area of external elements $\sum A$, m ²			163.03				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	45.87	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						167.94	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.04	(36)
Total fabric heat loss					(33) + (36) =	51.91	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
37.23	37.00	36.76	35.67	35.46	34.51	34.51	34.33	34.88	35.46	35.88	36.31	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
89.14	88.91	88.67	87.58	87.37	86.42	86.42	86.24	86.79	87.37	87.79	88.22	
Average = $\Sigma(39)1...12/12 =$											87.58	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.16	1.15	1.15	1.14	1.13	1.12	1.12	1.12	1.13	1.13	1.14	1.14	
Average = $\Sigma(40)1...12/12 =$											1.14	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.33	(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
100.46	96.81	93.16	89.50	85.85	82.20	82.20	85.85	89.50	93.16	96.81	100.46	
$\sum(44)1...12 =$											1095.98	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
148.99	130.30	134.46	117.23	112.48	97.06	89.94	103.21	104.44	121.72	132.87	144.29	
										$\Sigma(45)1...12 =$	1437.00	(45)

Distribution loss 0.15 x (45)m												
22.35	19.55	20.17	17.58	16.87	14.56	13.49	15.48	15.67	18.26	19.93	21.64	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

163.10	143.03	148.52	130.79	126.47	110.57	103.88	117.18	117.98	135.75	146.49	158.39	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

163.10	143.03	148.52	130.79	126.47	110.57	103.88	117.18	117.98	135.75	146.49	158.39	
$\Sigma(64)1...12 =$											1602.15	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.07	46.51	48.22	42.37	40.90	35.65	33.39	37.81	38.11	43.98	47.58	51.50	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

144.33	144.33	144.33	144.33	144.33	144.33	144.33	144.33	144.33	144.33	144.33	144.33	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

49.87	44.29	36.02	27.27	20.38	17.21	18.59	24.17	32.44	41.19	48.08	51.25	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

318.32	321.62	313.30	295.58	273.21	252.18	238.14	234.84	243.16	260.88	283.25	304.27	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	-96.22	(71)
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Water heating gains (Table 5)

71.33	69.21	64.82	58.85	54.97	49.51	44.88	50.82	52.93	59.11	66.09	69.22	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

542.46	538.07	517.08	484.64	451.51	421.86	404.56	412.78	431.48	464.13	500.36	527.70	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
East	0.77	x 6.01	x 19.64	x 0.9	x 0.71	x 0.70	= 40.65 (76)
West	0.77	x 4.67	x 19.64	x 0.9	x 0.71	x 0.70	= 31.59 (80)
North	0.77	x 1.32	x 10.63	x 0.9	x 0.71	x 0.70	= 4.83 (74)

Solar gains in watts $\Sigma(74)m...(82)m$

77.08	150.57	248.44	364.66	449.97	462.22	439.38	375.19	289.57	178.69	96.04	63.44	(83)
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Total gains - internal and solar (73)m + (83)m

619.54	688.63	765.53	849.30	901.48	884.07	843.94	787.97	721.05	642.83	596.41	591.14	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.96	0.94	0.87	0.75	0.58	0.44	0.48	0.71	0.90	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.55	19.74	20.06	20.47	20.77	20.93	20.98	20.97	20.86	20.46	19.93	19.51	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.99	19.98	19.97	19.97	19.96	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.92	0.84	0.69	0.50	0.34	0.39	0.64	0.87	0.95	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.05	18.32	18.78	19.35	19.74	19.93	19.98	19.97	19.86	19.35	18.61	18.00	(90)
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Living area fraction

Living area ÷ (4) = 0.25 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.43	18.68	19.11	19.63	20.00	20.19	20.23	20.23	20.11	19.63	18.95	18.39	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.28	18.53	18.96	19.48	19.85	20.04	20.08	20.08	19.96	19.48	18.80	18.24	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.94	0.90	0.82	0.69	0.51	0.35	0.39	0.64	0.86	0.94	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

594.97	649.06	692.03	698.05	620.32	448.67	296.89	310.98	458.98	550.53	560.79	570.74	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1246.08	1211.90	1104.75	926.74	712.26	469.99	300.86	317.13	508.76	775.96	1027.17	1238.22	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

484.43	378.23	307.06	164.66	68.41	0.00	0.00	0.00	0.00	167.72	335.79	496.60	
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Σ(98)1...5, 10...12 = 2402.89 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 31.17 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

535.28	417.93	339.30	181.94	75.59	0.00	0.00	0.00	0.00	185.32	371.04	548.73	
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Σ(211)1...5, 10...12 = 2655.13 (211)

Water heating

Efficiency of water heater

89.67	89.60	89.43	89.05	88.40	87.30	87.30	87.30	87.30	89.04	89.50	89.70	(217)
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Water heating fuel, kWh/month

181.89	159.64	166.07	146.87	143.07	126.65	118.99	134.23	135.15	152.46	163.67	176.57	
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Σ(219a)1...12 = 1805.24 (219)

Annual totals

Space heating fuel - main system 1

2655.13

Water heating fuel

1805.24

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	352.26	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4887.63	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2655.13	x	3.48	x 0.01 =	92.40	(240)
Water heating	1805.24	x	3.48	x 0.01 =	62.82	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	352.26	x	13.19	x 0.01 =	46.46	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	331.58	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.14	(257)
SAP value	84.09	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2655.13	x	0.216	=	573.51	(261)
Water heating	1805.24	x	0.216	=	389.93	(264)
Space and water heating			(261) + (262) + (263) + (264) =		963.44	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	352.26	x	0.519	=	182.82	(268)
Total CO ₂ , kg/year				(265)...(271) =	1185.19	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.37	(273)
EI value					86.99	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2655.13	x	1.22	=	3239.26	(261)
Water heating	1805.24	x	1.22	=	2202.39	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5441.65	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	352.26	x	3.07	=	1081.44	(268)
Primary energy kWh/year					6753.34	(272)
Dwelling primary energy rate kWh/m ² /year					87.59	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	21/10/2021
Address	BMAI 00CI DS06 Maidstone Mid Terr, Part L 2013 Masonry, Barratt Developments		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.57 (1a)	x	2.33 (2a)	=	89.87 (3a)
+1	38.57 (1b)	x	2.56 (2b)	=	98.74 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		77.14 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		188.61 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.16 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area				5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)				0.41 (18)
Number of sides on which the dwelling is sheltered				2 (19)
Shelter factor			1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor			(18) x (20) =	0.35 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4

1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			10.68	1.24	13.20		(27)
Ground floor			38.57	0.12	4.63		(28a)
External wall			32.78	0.27	8.85		(29a)
Party wall			81.03	0.00	0.00		(32)
Roof			38.57	0.11	4.24		(30)
Total area of external elements $\sum A$, m ²			122.57				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	32.89	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						181.81	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						5.76	(36)
Total fabric heat loss					(33) + (36) =	38.65	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
37.25	37.01	36.78	35.68	35.48	34.52	34.52	34.35	34.89	35.48	35.89	36.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
75.90	75.67	75.43	74.34	74.13	73.18	73.18	73.00	73.55	74.13	74.55	74.98	
Average = $\Sigma(39)1...12/12 =$											74.34	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.95	0.95	0.96	0.97	0.97	
Average = $\Sigma(40)1...12/12 =$											0.96	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.41	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.35	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
100.49	96.83	93.18	89.52	85.87	82.22	82.22	85.87	89.52	93.18	96.83	100.49	
										$\Sigma(44)1...12 =$	1096.21	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
149.02	130.33	134.49	117.25	112.51	97.08	89.96	103.23	104.47	121.75	132.90	144.32	
										$\Sigma(45)1...12 =$	1437.31	(45)

Distribution loss 0.15 x (45)m												
22.35	19.55	20.17	17.59	16.88	14.56	13.49	15.49	15.67	18.26	19.93	21.65	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

163.13	143.06	148.55	130.82	126.49	110.59	103.90	117.20	118.00	135.77	146.52	158.42	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

163.13	143.06	148.55	130.82	126.49	110.59	103.90	117.20	118.00	135.77	146.52	158.42	
$\Sigma(64)1...12 =$											1602.46	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.08	46.52	48.23	42.38	40.91	35.66	33.40	37.82	38.12	43.99	47.59	51.51	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
144.38	144.38	144.38	144.38	144.38	144.38	144.38	144.38	144.38	144.38	144.38	144.38	(66)

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

51.14	45.42	36.94	27.97	20.90	17.65	19.07	24.79	33.27	42.24	49.30	52.56	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

318.45	321.75	313.42	295.70	273.32	252.29	238.24	234.93	243.26	260.99	283.36	304.40	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	51.84	(69)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	-96.25	(71)
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Water heating gains (Table 5)

71.34	69.22	64.83	58.86	54.98	49.52	44.89	50.83	52.94	59.12	66.10	69.23	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

543.90	539.37	518.16	485.49	452.18	422.43	405.16	413.52	432.44	465.33	501.74	529.16	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
East	0.77	6.01	19.64	0.9	0.71	40.65	(76)
West	0.77	4.67	19.64	0.9	0.71	31.59	(80)

Solar gains in watts $\Sigma(74)m...(82)m$

72.25	141.33	232.74	339.44	416.00	425.85	405.43	348.26	270.69	167.70	90.08	59.41	(83)
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Total gains - internal and solar (73)m + (83)m

616.14	680.69	750.91	824.94	868.18	848.28	810.59	761.78	703.14	633.02	591.82	588.57	(84)
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7. Mean internal temperature (heating season)

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

												21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.93	0.85	0.71	0.53	0.39	0.43	0.67	0.89	0.96	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.93	20.09	20.36	20.68	20.89	20.98	21.00	20.99	20.94	20.66	20.24	19.90	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.10	20.10	20.10	20.11	20.12	20.13	20.13	20.13	20.12	20.12	20.11	20.11	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.92	0.82	0.66	0.47	0.32	0.36	0.60	0.86	0.95	0.98	(98)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.68	18.92	19.30	19.74	20.00	20.11	20.12	20.12	20.07	19.73	19.15	18.64	(90)
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Living area fraction

Living area ÷ (4) = 0.25 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.00	19.22	19.57	19.98	20.23	20.33	20.35	20.35	20.29	19.97	19.43	18.96	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.85	19.07	19.42	19.83	20.08	20.18	20.20	20.20	20.14	19.82	19.28	18.81	(93)
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5. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.95	0.91	0.81	0.66	0.47	0.32	0.36	0.60	0.85	0.94	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

594.59	644.44	679.59	669.70	574.61	400.54	262.05	275.30	422.10	536.91	558.37	570.98	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1104.20	1072.09	974.89	812.70	621.08	408.28	263.12	277.06	444.27	683.41	907.83	1095.61	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

379.15	287.38	219.70	102.97	34.57	0.00	0.00	0.00	0.00	109.00	251.61	390.33	
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Σ(98)1...5, 10...12 = 1774.72 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 23.01 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

418.95	317.55	242.76	113.77	38.20	0.00	0.00	0.00	0.00	120.44	278.02	431.30	
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Σ(211)1...5, 10...12 = 1961.01 (211)

Water heating

Efficiency of water heater

89.51	89.41	89.18	88.68	87.97	87.30	87.30	87.30	87.30	88.70	89.30	89.55	(217)
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Water heating fuel, kWh/month

182.24	160.00	166.57	147.51	143.80	126.68	119.01	134.25	135.17	153.08	164.08	176.90	
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Σ(219a)1...12 = 1809.30 (219)

Annual totals

Space heating fuel - main system 1

1961.01

Water heating fuel

1809.30

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	361.26	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4206.57 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1961.01	x	3.48	x 0.01 =	68.24	(240)
Water heating	1809.30	x	3.48	x 0.01 =	62.96	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	361.26	x	13.19	x 0.01 =	47.65	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		308.75	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.06	(257)
SAP value	85.19	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1961.01	x	0.216	=	423.58	(261)
Water heating	1809.30	x	0.216	=	390.81	(264)
Space and water heating			(261) + (262) + (263) + (264) =		814.39	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	361.26	x	0.519	=	187.49	(268)
Total CO ₂ , kg/year			(265)...(271) =		1040.80	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		13.49	(273)
EI value					88.58	
EI rating (section 14)					89	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1961.01	x	1.22	=	2392.43	(261)
Water heating	1809.30	x	1.22	=	2207.35	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4599.78	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	361.26	x	3.07	=	1109.06	(268)
Primary energy kWh/year					5939.09	(272)
Dwelling primary energy rate kWh/m ² /year					76.99	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BMMS 00CD DS07 Moresby Detached, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	40.44 (1a)	x	2.33 (2a)	=	94.23 (3a)
+1	40.44 (1b)	x	2.56 (2b)	=	103.53 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				80.88 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				197.75 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 40	÷ (5) =	0.20 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.45 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor	1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.38 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.60
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.60	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			15.06	1.24	18.61		(27)
Ground floor			40.44	0.14	5.66		(28a)
External wall			111.20	0.27	30.02		(29a)
Roof			40.44	0.11	4.45		(30)
Total area of external elements ΣA, m ²			209.11				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	60.71	(33)
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						191.18	(35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						6.51	(36)
Total fabric heat loss					(33) + (36) =	67.22	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
40.49	40.18	39.88	38.48	38.21	36.99	36.99	36.76	37.46	38.21	38.75	39.30	(38)

Heat transfer coefficient, W/K (37)m + (38)m	107.71	107.40	107.10	105.70	105.44	104.21	104.21	103.99	104.68	105.44	105.97	106.52	
Average = Σ(39)1...12/12 =	105.70												(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.33	1.33	1.32	1.31	1.30	1.29	1.29	1.29	1.29	1.30	1.31	1.32	
Average = Σ(40)1...12/12 =	1.31												(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.48	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.08	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
	102.39	98.67	94.95	91.22	87.50	83.78	83.78	87.50	91.22	94.95	98.67	102.39
	Σ(44)1...12 =										1117.01	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	151.85	132.81	137.04	119.48	114.64	98.93	91.67	105.19	106.45	124.06	135.42	147.05	
Σ(45)1...12 =	1464.58												(45)

Distribution loss 0.15 x (45)m	22.78	19.92	20.56	17.92	17.20	14.84	13.75	15.78	15.97	18.61	20.31	22.06	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c	14.12	12.74	14.07	13.57	14.00	13.51	13.94	13.98	13.55	14.04	13.63	14.11	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.97	145.55	151.11	133.05	128.64	112.44	105.61	119.17	120.00	138.10	149.05	161.16	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

165.97	145.55	151.11	133.05	128.64	112.44	105.61	119.17	120.00	138.10	149.05	161.16	
$\Sigma(64)1...12 =$											1629.84	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

54.02	47.34	49.08	43.12	41.62	36.27	33.97	38.47	38.78	44.76	48.43	52.42	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

50.11	44.51	36.20	27.40	20.48	17.29	18.69	24.29	32.60	41.39	48.31	51.50	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

330.25	333.68	325.04	306.66	283.45	261.64	247.07	243.64	252.28	270.66	293.87	315.68	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

72.61	70.45	65.97	59.89	55.94	50.38	45.65	51.71	53.86	60.16	67.27	70.46	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

557.91	553.58	532.16	498.89	464.82	434.25	416.35	424.58	443.68	477.16	514.40	542.59	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
NorthWest	0.77	x 5.35	x 11.28	x 0.9	x 0.71	x 0.70	= 20.79 (81)
NorthEast	0.77	x 5.34	x 11.28	x 0.9	x 0.71	x 0.70	= 20.75 (75)
SouthEast	0.77	x 3.71	x 36.79	x 0.9	x 0.71	x 0.70	= 47.02 (77)
SouthWest	0.77	x 0.66	x 36.79	x 0.9	x 0.71	x 0.70	= 8.36 (79)

Solar gains in watts $\Sigma(74)m...(82)m$

96.92	178.89	281.42	410.13	515.45	536.39	506.87	424.52	325.40	207.60	118.60	81.32	(83)
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Total gains - internal and solar (73)m + (83)m

654.83	732.47	813.57	909.02	980.26	970.64	923.22	849.10	769.08	684.75	633.00	623.91	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.95	0.90	0.79	0.62	0.48	0.53	0.76	0.93	0.97	0.99	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.42	19.61	19.93	20.36	20.71	20.91	20.98	20.96	20.81	20.36	19.82	19.39	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.82	19.82	19.82	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.83	19.83	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.87	0.73	0.53	0.36	0.41	0.68	0.90	0.97	0.98	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.75	18.02	18.49	19.10	19.56	19.79	19.84	19.84	19.69	19.12	18.35	17.71	(90)
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Living area fraction

Living area ÷ (4) = 0.20 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.07	18.33	18.77	19.35	19.78	20.01	20.06	20.06	19.91	19.36	18.63	18.04	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.92	18.18	18.62	19.20	19.63	19.86	19.91	19.91	19.76	19.21	18.48	17.89	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.96	0.92	0.85	0.72	0.53	0.37	0.42	0.68	0.88	0.95	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

635.44	700.09	752.12	774.65	707.16	518.07	339.64	355.67	520.13	604.52	603.96	608.01	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1467.51	1426.70	1298.48	1088.32	836.27	548.07	345.10	364.53	592.55	907.82	1206.32	1458.00	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

619.06	488.28	406.50	225.84	96.05	0.00	0.00	0.00	0.00	225.65	433.70	632.39	
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Σ(98)1...5, 10...12 = 3127.47 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 38.67 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

684.04	539.53	449.17	249.55	106.13	0.00	0.00	0.00	0.00	249.34	479.22	698.78	
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Σ(211)1...5, 10...12 = 3455.76 (211)

Water heating

Efficiency of water heater

89.80	89.74	89.61	89.29	88.64	87.30	87.30	87.30	87.30	89.26	89.66	89.83	(217)
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Water heating fuel, kWh/month

184.81	162.18	168.63	149.02	145.13	128.80	120.98	136.51	137.45	154.72	166.24	179.41	
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Σ(219a)1...12 = 1833.85 (219)

Annual totals

Space heating fuel - main system 1

3455.76

Water heating fuel

1833.85

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	353.98	(232)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-3132.47	(233)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	2586.13 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3455.76	x	3.48	x 0.01 =	120.26	(240)
Water heating	1833.85	x	3.48	x 0.01 =	63.82	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	353.98	x	13.19	x 0.01 =	46.69	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-3132.47	x	13.19	x 0.01 =	-413.17	(252)
Total energy cost			(240)...(242) + (245)...(254) =		-52.51	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	-0.18	(257)
SAP value	102.44	
SAP rating (section 13)	102	(258)
SAP band	A	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3455.76	x	0.216	=	746.44	(261)
Water heating	1833.85	x	0.216	=	396.11	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1142.56	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	353.98	x	0.519	=	183.72	(268)
Energy saving/generation technologies						
pv savings	-3132.47	x	0.519	=	-1625.75	(269)
Total CO ₂ , kg/year			(265)...(271) =		-260.55	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		-3.22	(273)
EI value					102.77	
EI rating (section 14)					103	(274)
EI band					A	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3455.76	x	1.22	=	4216.03	(281)
Water heating	1833.85	x	1.22	=	2237.30	(284)
Space and water heating			(281) + (282) + (283) + (284) =		6453.33	(285)
Pumps and fans	75.00	x	3.07	=	230.25	(287)

Electricity for lighting	353.98	x	3.07	=	1086.73	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-3132.47	x	3.07	=	-9616.68	(269)
Primary energy kWh/year					-1846.36	(272)
Dwelling primary energy rate kWh/m2/year					-22.83	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	BMMS 00CE DS07 Moresby EOT, Barratt Developments		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	40.44 (1a)	x	2.33 (2a)	=	94.23 (3a)
+1	40.44 (1b)	x	2.56 (2b)	=	103.53 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				80.88 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				197.75 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	4	x 10 =	40 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

					Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.20	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.45 (18)
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Number of sides on which the dwelling is sheltered	2 (19)
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Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.38 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft

0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.60
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.60	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.97	1.00	1.97		(26)
Window			14.40	1.24	17.79		(27)
Ground floor			40.44	0.13	5.26		(28a)
External wall			71.34	0.27	19.26		(29a)
Party wall			40.52	0.00	0.00		(32)
Roof			40.44	0.11	4.45		(30)
Total area of external elements $\sum A$, m ²			168.59				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	48.73	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						203.83	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.01	(36)
Total fabric heat loss					(33) + (36) =	54.74	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
40.49	40.18	39.88	38.48	38.21	36.99	36.99	36.76	37.46	38.21	38.75	39.30	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
95.22	94.92	94.62	93.22	92.95	91.73	91.73	91.50	92.20	92.95	93.48	94.04	
Average = $\Sigma(39)1...12/12 =$											93.21	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.18	1.17	1.17	1.15	1.15	1.13	1.13	1.13	1.14	1.15	1.16	1.16	
Average = $\Sigma(40)1...12/12 =$											1.15	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.08	(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
102.39	98.67	94.95	91.22	87.50	83.78	83.78	87.50	91.22	94.95	98.67	102.39	
$\sum(44)1...12 =$											1117.01	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
151.85	132.81	137.04	119.48	114.64	98.93	91.67	105.19	106.45	124.06	135.42	147.05	
										$\sum(45)1...12 =$	1464.58	(45)

Distribution loss 0.15 x (45)m												
22.78	19.92	20.56	17.92	17.20	14.84	13.75	15.78	15.97	18.61	20.31	22.06	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.12	12.74	14.07	13.57	14.00	13.51	13.94	13.98	13.55	14.04	13.63	14.11	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

165.97	145.55	151.11	133.05	128.64	112.44	105.61	119.17	120.00	138.10	149.05	161.16	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

165.97	145.55	151.11	133.05	128.64	112.44	105.61	119.17	120.00	138.10	149.05	161.16	
$\Sigma(64)1...12 =$											1629.84	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

54.02	47.34	49.08	43.12	41.62	36.27	33.97	38.47	38.78	44.76	48.43	52.42	(65)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	148.76	(66)

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

50.46	44.82	36.45	27.59	20.63	17.41	18.82	24.46	32.83	41.68	48.65	51.86	(67)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

330.25	333.68	325.04	306.66	283.45	261.64	247.07	243.64	252.28	270.66	293.87	315.68	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	52.36	(69)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	-99.17	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

72.61	70.45	65.97	59.89	55.94	50.38	45.65	51.71	53.86	60.16	67.27	70.46	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

558.26	553.89	532.41	499.08	464.96	434.37	416.48	424.75	443.91	477.45	514.73	542.95	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 5.35	x 19.64	x 0.9 x 0.71	x 0.70	= 36.19	(80)
North	0.77	x 5.34	x 10.63	x 0.9 x 0.71	x 0.70	= 19.56	(74)
East	0.77	x 3.71	x 19.64	x 0.9 x 0.71	x 0.70	= 25.10	(76)

Solar gains in watts $\Sigma(74)m...(82)m$

80.84	157.26	260.95	389.97	490.32	508.37	481.28	404.40	305.99	186.75	100.54	66.70	(83)
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Total gains - internal and solar (73)m + (83)m

639.10	711.15	793.36	889.05	955.28	942.74	897.76	829.15	749.90	664.19	615.27	609.65	(84)
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7. Mean internal temperature (heating season)

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

												21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.96	0.89	0.77	0.59	0.44	0.49	0.74	0.93	0.98	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.70	19.87	20.17	20.55	20.82	20.96	20.99	20.98	20.89	20.52	20.05	19.68	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.94	19.94	19.94	19.96	19.96	19.97	19.97	19.98	19.97	19.96	19.96	19.95	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.87	0.71	0.51	0.34	0.39	0.66	0.90	0.97	0.99	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.23	18.48	18.91	19.44	19.79	19.94	19.97	19.97	19.88	19.42	18.75	18.20	(90)
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Living area fraction

Living area ÷ (4) = 0.20 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.52	18.75	19.15	19.65	19.99	20.14	20.17	20.17	20.08	19.64	19.01	18.49	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.37	18.60	19.00	19.50	19.84	19.99	20.02	20.02	19.93	19.49	18.86	18.34	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.98	0.96	0.93	0.85	0.71	0.51	0.35	0.39	0.66	0.89	0.96	0.98	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

623.93	684.75	738.25	756.35	674.85	479.69	311.41	327.20	493.60	589.45	591.35	597.41	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1339.91	1300.81	1183.06	988.44	756.69	494.58	313.57	330.94	537.17	826.00	1099.11	1329.74	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

532.69	413.99	330.94	167.11	60.89	0.00	0.00	0.00	0.00	175.99	365.59	544.85	
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Σ(98)1...5, 10...12 = 2592.05 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 32.05 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

588.60	457.45	365.68	184.65	67.29	0.00	0.00	0.00	0.00	194.47	403.96	602.05	
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Σ(211)1...5, 10...12 = 2864.14 (211)

Water heating

Efficiency of water heater

89.72	89.65	89.47	89.05	88.30	87.30	87.30	87.30	87.30	89.06	89.55	89.75	(217)
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Water heating fuel, kWh/month

184.99	162.36	168.89	149.41	145.68	128.80	120.98	136.51	137.45	155.05	166.45	179.57	
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Σ(219a)1...12 = 1836.12 (219)

Annual totals

Space heating fuel - main system 1

2864.14

Water heating fuel

1836.12

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	356.44	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 5131.71	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2864.14	x	3.48	x 0.01 =	99.67	(240)
Water heating	1836.12	x	3.48	x 0.01 =	63.90	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	356.44	x	13.19	x 0.01 =	47.02	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	340.48	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.14	(257)
SAP value	84.15	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2864.14	x	0.216	=	618.65	(261)
Water heating	1836.12	x	0.216	=	396.60	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1015.26	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	356.44	x	0.519	=	184.99	(268)
Total CO ₂ , kg/year				(265)...(271) =	1239.18	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.32	(273)
EI value					86.81	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2864.14	x	1.22	=	3494.25	(261)
Water heating	1836.12	x	1.22	=	2240.07	(264)
Space and water heating				(261) + (262) + (263) + (264) =	5734.32	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	356.44	x	3.07	=	1094.28	(268)
Primary energy kWh/year					7058.85	(272)
Dwelling primary energy rate kWh/m ² /year					87.28	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	21/10/2021
Address	T322-E-7 Greenwood EOT, David Wilson Homes		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.70 (1a)	x	2.39 (2a)	=	92.49 (3a)
+1	36.10 (1b)	x	2.63 (2b)	=	94.94 (3b)
+2	36.10 (1c)	x	1.78 (2c)	=	64.26 (3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				110.90 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				251.69 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) = 0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
Number of sides on which the dwelling is sheltered	2 (19)
Shelter factor	1 - [0.075 x (19)] = 0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.31 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.35	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			1.76	1.10	1.94		(26)
Window			16.78	1.24	20.74		(27)
Roof window			4.04	1.42	5.72		(27a)
Ground floor			38.80	0.14	5.43		(28a)
External wall			97.51	0.27	26.33		(29a)
External wall			1.90	0.30	0.57		(29a)
Party wall			72.22	0.00	0.00		(32)
External wall			16.62	0.22	3.66		(29a)
Roof			43.65	0.16	6.98		(30)
Roof			2.80	0.17	0.48		(30)
Total area of external elements ΣA , m ²			223.86				(31)
Fabric heat loss, W/K = $\Sigma(A \times U)$					(26)...(30) + (32) =	71.83	(33)
Heat capacity Cm = $\Sigma(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						206.56	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K						10.82	(36)
Total fabric heat loss					(33) + (36) =	82.65	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)											
48.20	47.94	47.68	46.49	46.27	45.23	45.23	45.04	45.63	46.27	46.72	47.19

Heat transfer coefficient, W/K (37)m + (38)m	130.85	130.59	130.34	129.14	128.92	127.88	127.88	127.69	128.28	128.92	129.37	129.84	
Average = $\Sigma(39)1...12/12 =$	129.14												(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17	
Average = $\Sigma(40)1...12/12 =$	1.16												(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.82	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.18	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
111.30	107.25	103.20	99.15	95.11	91.06	91.06	95.11	99.15	103.20	107.25	111.30	
										$\Sigma(44)1...12 =$	1214.13	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	165.05	144.35	148.96	129.87	124.61	107.53	99.64	114.34	115.70	134.84	147.19	159.84	
$\Sigma(45)1...12 =$	1591.92												(45)

Distribution loss 0.15 x (45)m	24.76	21.65	22.34	19.48	18.69	16.13	14.95	17.15	17.36	20.23	22.08	23.98	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.15	12.77	14.11	13.62	14.04	13.55	13.97	14.02	13.59	14.08	13.67	14.14	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

179.20	157.12	163.07	143.49	138.65	121.08	113.62	128.36	129.29	148.92	160.86	173.98	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

179.20	157.12	163.07	143.49	138.65	121.08	113.62	128.36	129.29	148.92	160.86	173.98	
$\Sigma(64)1...12 =$											1757.64	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

58.42	51.19	53.06	46.59	44.94	39.14	36.62	41.52	41.87	48.36	52.36	56.68	(65)
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5. Internal gains

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

169.21	169.21	169.21	169.21	169.21	169.21	169.21	169.21	169.21	169.21	169.21	169.21	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

61.41	54.54	44.35	33.58	25.10	21.19	22.90	29.76	39.95	50.72	59.20	63.11	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

407.23	411.45	400.81	378.14	349.52	322.62	304.65	300.43	311.08	333.75	362.36	389.26	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	-112.80	(71)
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Water heating gains (Table 5)

78.52	76.18	71.31	64.70	60.41	54.36	49.23	55.81	58.15	64.99	72.72	76.19	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

661.29	656.31	630.62	590.56	549.17	512.32	490.92	500.15	523.32	563.61	608.43	642.70	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	4.82	x	46.75	x 0.9 x	0.72	x	0.70	=	78.71	(78)
West	0.77	x	2.55	x	19.64	x 0.9 x	0.72	x	0.70	=	17.49	(80)
North	0.77	x	7.52	x	10.63	x 0.9 x	0.72	x	0.70	=	27.93	(74)
North	1.00	x	3.27	x	15.69	x 0.9 x	0.72	x	0.70	=	23.27	(74)
East	0.77	x	1.89	x	19.64	x 0.9 x	0.72	x	0.70	=	12.97	(76)
South	1.00	x	0.77	x	45.64	x 0.9 x	0.72	x	0.70	=	15.94	(78)

Solar gains in watts $\Sigma(74)m...(82)m$

176.31	314.26	474.01	672.50	839.24	873.20	825.04	693.06	540.79	358.52	213.55	149.44	(83)
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Total gains - internal and solar (73)m + (83)m

837.60	970.58	1104.63	1263.06	1388.41	1385.52	1315.96	1193.21	1064.11	922.13	821.97	792.14	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area n1,m (see Table 9a)												(86)
	0.99	0.98	0.96	0.89	0.75	0.56	0.42	0.48	0.73	0.93	0.98	0.99
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												(87)
	19.68	19.88	20.18	20.57	20.84	20.96	20.99	20.99	20.89	20.52	20.03	19.64
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)												(88)
	19.94	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.95	19.94
Utilisation factor for gains for rest of dwelling n2,m												(89)
	0.99	0.97	0.94	0.86	0.69	0.48	0.32	0.38	0.65	0.90	0.97	0.99
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												(90)
	18.19	18.48	18.92	19.45	19.80	19.93	19.95	19.95	19.87	19.41	18.71	18.14
Living area fraction	Living area ÷ (4) =										0.22	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												(92)
	18.52	18.79	19.20	19.70	20.03	20.16	20.18	20.18	20.09	19.66	19.00	18.47
Apply adjustment to the mean internal temperature from Table 4e where appropriate												(93)
	18.37	18.64	19.05	19.55	19.88	20.01	20.03	20.03	19.94	19.51	18.85	18.32

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm												(94)
	0.98	0.96	0.93	0.84	0.69	0.49	0.33	0.38	0.65	0.89	0.97	0.98
Useful gains, ηmGm, W (94)m x (84)m												(95)
	821.16	936.45	1027.30	1065.42	952.71	673.94	436.20	458.54	691.65	818.91	793.69	779.44
Monthly average external temperature from Table U1												(96)
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												(97)
	1840.69	1793.83	1635.66	1374.99	1054.22	691.64	438.76	463.32	749.72	1148.22	1520.20	1832.83
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												(98)
	758.53	576.16	452.62	222.89	75.52	0.00	0.00	0.00	0.00	245.01	523.08	783.72
	Σ(98)1...5, 10...12 =										3637.54	(98)
Space heating requirement kWh/m²/year	(98) ÷ (4)										32.80	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating												
Fraction of space heat from secondary/supplementary system (table 11)	0.00											(201)
Fraction of space heat from main system(s)	1 - (201) =										1.00	(202)
Fraction of space heat from main system 2	0.00											(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =										1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =										0.00	(205)
Efficiency of main system 1 (%)	90.50											(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												(211)
	838.15	636.65	500.13	246.29	83.45	0.00	0.00	0.00	0.00	270.73	577.99	865.99
	Σ(211)1...5, 10...12 =										4019.38	(211)

Water heating

Efficiency of water heater

89.87	89.79	89.63	89.22	88.40	87.30	87.30	87.30	87.30	89.26	89.73	89.90	(217)
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Water heating fuel, kWh/month

199.40	174.98	181.94	160.83	156.84	138.69	130.14	147.03	148.10	166.84	179.28	193.52	
$\Sigma(219a)1...12 =$											1977.59	(219)

Annual totals

Space heating fuel - main system 1											4019.38	
Water heating fuel											1977.59	
Electricity for pumps, fans and electric keep-hot (Table 4f)												
central heating pump or water pump within warm air heating unit								30.00				(230c)
boiler flue fan								45.00				(230e)
Total electricity for the above, kWh/year											75.00	(231)
Electricity for lighting (Appendix L)											433.78	(232)
Total delivered energy for all uses											(211)...(221) + (231) + (232)...(237b) =	6505.74 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4019.38	x	3.48	x 0.01 =	139.87	(240)
Water heating	1977.59	x	3.48	x 0.01 =	68.82	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	433.78	x	13.19	x 0.01 =	57.21	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	395.80	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.07	(257)
SAP value					85.13	
SAP rating (section 13)					85	(258)
SAP band					B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4019.38	x	0.216	=	868.19	(261)
Water heating	1977.59	x	0.216	=	427.16	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1295.35	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	433.78	x	0.519	=	225.13	(268)
Total CO ₂ , kg/year				(265)...(271) =	1559.40	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	14.06	(273)
EI value					86.60	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4019.38	x	1.22	=	4903.65	(261)
Water heating	1977.59	x	1.22	=	2412.66	(264)

Space and water heating			(261) + (262) + (263) + (264) =	7316.30	(265)
Pumps and fans	75.00	x	3.07	=	230.25 (267)
Electricity for lighting	433.78	x	3.07	=	1331.69 (268)
Primary energy kWh/year					8878.24 (272)
Dwelling primary energy rate kWh/m2/year					80.06 (273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B51F 00EC Type 51 EOT, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.43 (1a)	x	2.31 (2a)	=	88.77 (3a)
+1	38.43 (1b)	x	2.56 (2b)	=	98.38 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		76.86 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		187.15 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.16 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.41 (18)
Number of sides on which the dwelling is sheltered			3 (19)
Shelter factor		1 - [0.075 x (19)] =	0.78 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.32 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.41	0.40	0.39	0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			10.39	1.24	12.84		(27)
Ground floor			38.43	0.14	5.38		(28a)
External wall			70.74	0.27	19.10		(29a)
Party wall			39.91	0.00	0.00		(32)
Roof			38.43	0.11	4.23		(30)
Total area of external elements $\sum A$, m ²			162.27				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	48.82	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						160.90	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.06	(36)
Total fabric heat loss					(33) + (36) =	54.88	(37)

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

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

35.97	35.77	35.58	34.67	34.50	33.71	33.71	33.56	34.01	34.50	34.84	35.20	(38)
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Heat transfer coefficient, W/K (37)m + (38)m

90.85	90.65	90.45	89.55	89.38	88.58	88.58	88.44	88.89	89.38	89.72	90.08	
Average = $\sum(39)1...12/12 =$											89.54	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.18	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.17	
Average = $\sum(40)1...12/12 =$											1.17	(40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N												2.40	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36												91.21	(43)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

100.34	96.69	93.04	89.39	85.74	82.09	82.09	85.74	89.39	93.04	96.69	100.34	
$\sum(44)1...12 =$											1094.57	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

148.79	130.14	134.29	117.08	112.34	96.94	89.83	103.08	104.31	121.56	132.70	144.10	
$\sum(45)1...12 =$											1435.15	(45)

Distribution loss 0.15 x (45)m

22.32	19.52	20.14	17.56	16.85	14.54	13.47	15.46	15.65	18.23	19.90	21.61	(46)
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Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

162.91	142.86	148.35	130.64	126.33	110.44	103.76	117.05	117.85	135.59	146.32	158.20	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

162.91	142.86	148.35	130.64	126.33	110.44	103.76	117.05	117.85	135.59	146.32	158.20	
$\Sigma(64)1...12 =$											1600.29	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.00	46.45	48.17	42.32	40.85	35.61	33.35	37.77	38.07	43.93	47.53	51.44	(65)
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5 Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	(66)

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

51.26	45.53	37.03	28.03	20.95	17.69	19.12	24.85	33.35	42.34	49.42	52.69	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

317.54	320.84	312.53	294.86	272.54	251.57	237.56	234.26	242.57	260.24	282.56	303.53	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	(71)
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Water heating gains (Table 5)

71.24	69.13	64.74	58.78	54.90	49.46	44.83	50.76	52.87	59.04	66.01	69.14	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

542.86	538.31	517.12	484.48	451.22	421.53	404.32	412.69	431.60	464.45	500.81	528.17	(73)
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6 Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 4.95	x 19.64	x 0.9	x 0.71	x 0.70	= 33.48 (80)
North	0.77	x 1.32	x 10.63	x 0.9	x 0.71	x 0.70	= 4.83 (74)
East	0.77	x 4.12	x 19.64	x 0.9	x 0.71	x 0.70	= 27.87 (76)

Solar gains in watts $\Sigma(74)m...(82)m$

66.19	129.26	213.36	313.49	387.26	398.02	378.26	322.69	248.76	153.41	82.47	54.48	(83)
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Total gains - internal and solar (73)m + (83)m

609.05	667.57	730.47	797.97	838.48	819.55	782.58	735.38	680.36	617.86	583.27	582.66	(84)
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7 Mean internal temperature (heating season)

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

21.00	(85)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.98	0.96	0.94	0.88	0.78	0.62	0.48	0.52	0.74	0.91	0.96	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.44	19.62	19.94	20.36	20.70	20.90	20.97	20.96	20.81	20.37	19.84	19.40	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.95	19.95	19.95	19.94	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.93	0.86	0.73	0.54	0.37	0.42	0.67	0.88	0.95	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.88	18.15	18.61	19.19	19.63	19.88	19.94	19.94	19.79	19.23	18.47	17.84	(90)
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Living area fraction

Living area ÷ (4) = 0.44 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.57	18.80	19.19	19.70	20.10	20.33	20.40	20.39	20.24	19.73	19.07	18.53	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.42	18.65	19.04	19.55	19.95	20.18	20.25	20.24	20.09	19.58	18.92	18.38	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.95	0.91	0.84	0.73	0.56	0.40	0.45	0.68	0.87	0.94	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

584.99	631.09	666.90	673.77	610.60	458.83	314.87	327.66	460.99	537.51	549.68	562.42	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1282.72	1245.99	1134.66	953.80	737.48	494.36	322.94	339.38	532.40	802.71	1060.54	1276.91	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

519.11	413.22	348.01	201.63	94.40	0.00	0.00	0.00	0.00	197.31	367.82	531.59	
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Σ(98)1...5, 10...12 = 2673.07 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 34.78 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

573.60	456.59	384.54	222.79	104.30	0.00	0.00	0.00	0.00	218.02	406.43	587.39	
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Σ(211)1...5, 10...12 = 2953.67 (211)

Water heating

Efficiency of water heater

89.71	89.66	89.52	89.21	88.64	87.30	87.30	87.30	87.30	89.17	89.57	89.75	(217)
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Water heating fuel, kWh/month

181.58	159.35	165.71	146.43	142.51	126.51	118.86	134.08	134.99	152.06	163.36	176.28	
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Σ(219a)1...12 = 1801.73 (219)

Annual totals

Space heating fuel - main system 1

2953.67

Water heating fuel

1801.73

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	362.12	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5192.51 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2953.67	x	3.48	x 0.01 =	102.79	(240)
Water heating	1801.73	x	3.48	x 0.01 =	62.70	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	362.12	x	13.19	x 0.01 =	47.76	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	343.14	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.18	(257)
SAP value	83.50	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2953.67	x	0.216	=	637.99	(261)
Water heating	1801.73	x	0.216	=	389.17	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1027.17	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	362.12	x	0.519	=	187.94	(268)
Total CO ₂ , kg/year				(265)...(271) =	1254.03	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	16.32	(273)
EI value					86.21	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2953.67	x	1.22	=	3603.47	(261)
Water heating	1801.73	x	1.22	=	2198.11	(264)
Space and water heating				(261) + (262) + (263) + (264) =	5801.58	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	362.12	x	3.07	=	1111.71	(268)
Primary energy kWh/year					7143.54	(272)
Dwelling primary energy rate kWh/m ² /year					92.94	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B51F 00MC Type 51 Mid Terr, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	38.43 (1a)	x	2.31 (2a)	=	88.77 (3a)
+1	38.43 (1b)	x	2.56 (2b)	=	98.38 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		76.86 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		187.15 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.16 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.41 (18)
Number of sides on which the dwelling is sheltered			1 (19)
Shelter factor		1 - [0.075 x (19)] =	0.93 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.38 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.48	0.47	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.60
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.60	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			9.07	1.24	11.21		(27)
Ground floor			38.43	0.12	4.61		(28a)
External wall			30.46	0.27	8.22		(29a)
Party wall			83.18	0.00	0.00		(32)
Roof			38.43	0.11	4.23		(30)
Total area of external elements $\sum A$, m ²			120.67				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	35.55	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						175.80	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						5.72	(36)
Total fabric heat loss					(33) + (36) =	41.26	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
38.13	37.85	37.57	36.28	36.03	34.90	34.90	34.70	35.34	36.03	36.52	37.04	(38)

Heat transfer coefficient, W/K (37)m + (38)m											
79.39	79.11	78.84	77.54	77.30	76.17	76.17	75.96	76.60	77.30	77.79	78.30
Average = $\sum(39)1...12/12 =$										77.54	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)											
1.03	1.03	1.03	1.01	1.01	0.99	0.99	0.99	1.00	1.01	1.01	1.02
Average = $\sum(40)1...12/12 =$										1.01	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.40	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.21	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)											
100.34	96.69	93.04	89.39	85.74	82.09	82.09	85.74	89.39	93.04	96.69	100.34
$\sum(44)1...12 =$										1094.57	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)											
148.79	130.14	134.29	117.08	112.34	96.94	89.83	103.08	104.31	121.56	132.70	144.10
$\sum(45)1...12 =$										1435.15	(45)

Distribution loss 0.15 x (45)m												
22.32	19.52	20.14	17.56	16.85	14.54	13.47	15.46	15.65	18.23	19.90	21.61	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.11	12.73	14.06	13.56	13.99	13.50	13.93	13.97	13.54	14.03	13.62	14.10	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

162.91	142.86	148.35	130.64	126.33	110.44	103.76	117.05	117.85	135.59	146.32	158.20	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

162.91	142.86	148.35	130.64	126.33	110.44	103.76	117.05	117.85	135.59	146.32	158.20	
$\Sigma(64)1...12 =$											1600.29	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

53.00	46.45	48.17	42.32	40.85	35.61	33.35	37.77	38.07	43.93	47.53	51.44	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	144.03	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

52.83	46.92	38.16	28.89	21.59	18.23	19.70	25.61	34.37	43.64	50.93	54.30	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

317.54	320.84	312.53	294.86	272.54	251.57	237.56	234.26	242.57	260.24	282.56	303.53	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	51.80	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	-96.02	(71)
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Water heating gains (Table 5)

71.24	69.13	64.74	58.78	54.90	49.46	44.83	50.76	52.87	59.04	66.01	69.14	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

544.42	539.70	518.25	485.34	451.86	422.07	404.90	413.45	432.62	465.74	502.32	529.78	(73)
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6. Solar gains

Access factor
Table 6d

Area
m²

Solar flux
W/m²

g
specific data
or Table 6b

FF
specific data
or Table 6c

Gains
W

East $0.77 \times 4.95 \times 19.64 \times 0.9 \times 0.71 \times 0.70 = 33.48$ (76)

West $0.77 \times 4.12 \times 19.64 \times 0.9 \times 0.71 \times 0.70 = 27.87$ (80)

Solar gains in watts $\Sigma(74)m...(82)m$

61.35	120.02	197.66	288.27	353.29	361.66	344.31	295.76	229.89	142.42	76.50	50.45	(83)
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Total gains - internal and solar (73)m + (83)m

605.78	659.72	715.90	773.61	805.15	783.73	749.21	709.20	662.51	608.16	578.82	580.24	(84)
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7. Mean internal temperature (heating season)

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

21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.94	0.88	0.76	0.59	0.44	0.48	0.71	0.90	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.80	19.96	20.23	20.57	20.82	20.96	20.99	20.99	20.90	20.58	20.14	19.77	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.06	20.06	20.06	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.93	0.85	0.71	0.52	0.35	0.39	0.64	0.88	0.96	0.98	(88)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.47	18.70	19.09	19.57	19.90	20.06	20.09	20.09	20.00	19.59	18.97	18.44	(90)
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Living area fraction

Living area ÷ (4) = 0.44 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.05	19.25	19.59	20.01	20.31	20.45	20.48	20.48	20.40	20.03	19.48	19.02	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.90	19.10	19.44	19.86	20.16	20.30	20.33	20.33	20.25	19.88	19.33	18.87	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.97	0.95	0.92	0.84	0.72	0.53	0.38	0.42	0.65	0.87	0.95	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

585.52	628.00	657.94	653.50	577.10	418.22	281.58	294.36	432.94	528.65	548.71	563.41	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1159.23	1123.48	1020.13	850.03	653.63	434.38	284.38	298.62	471.01	717.12	951.72	1149.01	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

426.84	332.96	269.47	141.50	56.94	0.00	0.00	0.00	0.00	140.22	290.17	435.69	
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Σ(98)1...5, 10...12 = 2093.79 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 27.24 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

471.65	367.91	297.76	156.35	62.92	0.00	0.00	0.00	0.00	154.94	320.62	481.42	
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Σ(211)1...5, 10...12 = 2313.58 (211)

Water heating

Efficiency of water heater

89.59	89.51	89.34	88.94	88.27	87.30	87.30	87.30	87.30	88.90	89.40	89.62	(217)
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Water heating fuel, kWh/month

181.83	159.60	166.05	146.89	143.11	126.51	118.86	134.08	134.99	152.52	163.66	176.52	
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Σ(219a)1...12 = 1804.62 (219)

Annual totals

Space heating fuel - main system 1

2313.58

Water heating fuel

1804.62

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	373.18	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4566.38 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2313.58	x	3.48	x 0.01 =	80.51	(240)
Water heating	1804.62	x	3.48	x 0.01 =	62.80	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	373.18	x	13.19	x 0.01 =	49.22	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		322.43	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.11	(257)
SAP value	84.50	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2313.58	x	0.216	=	499.73	(261)
Water heating	1804.62	x	0.216	=	389.80	(264)
Space and water heating			(261) + (262) + (263) + (264) =		889.53	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	373.18	x	0.519	=	193.68	(268)
Total CO ₂ , kg/year			(265)...(271) =		1122.14	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		14.60	(273)
EI value					87.66	
EI rating (section 14)					88	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2313.58	x	1.22	=	2822.56	(261)
Water heating	1804.62	x	1.22	=	2201.64	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5024.20	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	373.18	x	3.07	=	1145.66	(268)
Primary energy kWh/year					6400.11	(272)
Dwelling primary energy rate kWh/m ² /year					83.27	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B52F 00EC Type 52 EOT, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	42.28 (1a)	x	2.31 (2a)	=	97.67 (3a)
+1	42.28 (1b)	x	2.56 (2b)	=	108.24 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				84.56 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				205.90 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

				Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) =	0.15 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40 (18)
--	-----------

Number of sides on which the dwelling is sheltered	3 (19)
--	--------

Shelter factor	1 - [0.075 x (19)] =	0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.31 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.39	0.38	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.55	0.55	0.56	0.57	(25)
------	------	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			10.67	1.24	13.19		(27)
Ground floor			42.28	0.13	5.50		(28a)
External wall			74.61	0.27	20.14		(29a)
Party wall			44.78	0.00	0.00		(32)
Roof			42.28	0.11	4.65		(30)
Total area of external elements $\sum A$, m ²			174.12				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	50.75	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						166.50	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.33	(36)
Total fabric heat loss					(33) + (36) =	57.09	(37)

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

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

39.18	38.98	38.78	37.85	37.68	36.86	36.86	36.71	37.18	37.68	38.03	38.40	(38)
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Heat transfer coefficient, W/K (37)m + (38)m

96.27	96.07	95.87	94.94	94.76	93.95	93.95	93.80	94.26	94.76	95.11	95.48	
Average = $\sum(39)1...12/12 =$											94.94	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.13	
Average = $\sum(40)1...12/12 =$											1.12	(40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.54	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.61	(43)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

104.07	100.29	96.51	92.72	88.94	85.15	85.15	88.94	92.72	96.51	100.29	104.07	
$\sum(44)1...12 =$											1135.36	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

154.34	134.99	139.29	121.44	116.52	100.55	93.18	106.92	108.20	126.09	137.64	149.47	
$\sum(45)1...12 =$											1488.63	(45)

Distribution loss 0.15 x (45)m

23.15	20.25	20.89	18.22	17.48	15.08	13.98	16.04	16.23	18.91	20.65	22.42	(46)
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Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
------	------	------	------	------	------	------	------	------	------	------	------	------

If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

14.13	12.75	14.08	13.58	14.01	13.52	13.95	13.98	13.55	14.05	13.64	14.12	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

168.47	147.74	153.37	135.02	130.53	114.07	107.12	120.91	121.75	140.14	151.28	163.58	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

168.47	147.74	153.37	135.02	130.53	114.07	107.12	120.91	121.75	140.14	151.28	163.58	
$\Sigma(64)1...12 =$											1653.99	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

54.85	48.07	49.83	43.77	42.25	36.81	34.47	39.05	39.36	45.44	49.18	53.23	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

55.95	49.70	40.42	30.60	22.87	19.31	20.86	27.12	36.40	46.22	53.94	57.51	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

341.35	344.90	335.97	316.97	292.98	270.43	255.37	251.83	260.76	279.76	303.75	326.29	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	(71)
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Water heating gains (Table 5)

73.72	71.53	66.98	60.80	56.78	51.13	46.33	52.48	54.67	61.07	68.30	71.54	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

577.71	572.80	550.05	515.04	479.31	447.55	429.24	438.11	458.51	493.73	532.67	562.02	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 4.95	x 19.64	x 0.9	x 0.71	x 0.70	= 33.48 (80)
North	0.77	x 1.32	x 10.63	x 0.9	x 0.71	x 0.70	= 4.83 (74)
East	0.77	x 4.40	x 19.64	x 0.9	x 0.71	x 0.70	= 29.76 (76)

Solar gains in watts $\Sigma(74)m... (82)m$

68.08	132.97	219.46	322.39	398.16	409.18	388.89	331.82	255.86	157.81	84.83	56.04	(83)
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Total gains - internal and solar (73)m + (83)m

645.79	705.77	769.51	837.43	877.48	856.74	818.14	769.94	714.37	651.54	617.50	618.06	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.95	0.89	0.79	0.63	0.49	0.53	0.75	0.92	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.52	19.69	20.00	20.39	20.72	20.91	20.98	20.97	20.83	20.41	19.90	19.49	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.97	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.98	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.94	0.87	0.74	0.56	0.38	0.43	0.68	0.89	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.02	18.27	18.70	19.26	19.69	19.92	19.98	19.97	19.84	19.30	18.57	17.97	(90)
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Living area fraction

Living area ÷ (4) = 0.23 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.36	18.59	19.00	19.52	19.92	20.15	20.20	20.20	20.06	19.55	18.87	18.32	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.21	18.44	18.85	19.37	19.77	20.00	20.05	20.05	19.91	19.40	18.72	18.17	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.95	0.92	0.85	0.73	0.56	0.39	0.43	0.68	0.87	0.95	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

622.68	670.47	707.07	712.65	642.53	475.92	318.54	333.19	482.29	569.77	584.58	598.73	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1339.25	1300.82	1183.72	993.63	764.86	507.02	324.59	342.25	547.73	833.91	1105.68	1333.56	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

533.12	423.59	354.63	202.30	91.01	0.00	0.00	0.00	0.00	196.52	375.19	546.71	
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Σ(98)1...5, 10...12 = 2723.08 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 32.20 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

589.09	468.06	391.85	223.54	100.57	0.00	0.00	0.00	0.00	217.14	414.58	604.10	
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Σ(211)1...5, 10...12 = 3008.92 (211)

Water heating

Efficiency of water heater

89.71	89.65	89.51	89.19	88.59	87.30	87.30	87.30	87.30	89.14	89.56	89.74	(217)
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Water heating fuel, kWh/month

187.79	164.79	171.35	151.39	147.35	130.66	122.71	138.49	139.46	157.22	168.93	182.28	
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Σ(219a)1...12 = 1862.41 (219)

Annual totals

Space heating fuel - main system 1

3008.92

Water heating fuel

1862.41

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	395.25	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 5341.59	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3008.92	x	3.48	x 0.01 =	104.71	(240)
Water heating	1862.41	x	3.48	x 0.01 =	64.81	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	395.25	x	13.19	x 0.01 =	52.13	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	351.55	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.14	(257)
SAP value	84.10	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3008.92	x	0.216	=	649.93	(261)
Water heating	1862.41	x	0.216	=	402.28	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1052.21	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	395.25	x	0.519	=	205.14	(268)
Total CO ₂ , kg/year				(265)...(271) =	1296.27	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.33	(273)
EI value					86.59	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3008.92	x	1.22	=	3670.89	(261)
Water heating	1862.41	x	1.22	=	2272.14	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5943.03	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	395.25	x	3.07	=	1213.42	(268)
Primary energy kWh/year					7386.70	(272)
Dwelling primary energy rate kWh/m ² /year					87.35	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B52F 00MC Type 52 Mid Terr, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	42.28 (1a)	x	2.31 (2a)	=	97.67 (3a)
+1	42.28 (1b)	x	2.56 (2b)	=	108.24 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		84.56 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		205.90 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.15 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.40 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.34 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.40

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			9.35	1.24	11.55		(27)
Ground floor			42.28	0.12	5.07		(28a)
External wall			31.14	0.27	8.41		(29a)
Party wall			89.57	0.00	0.00		(32)
Roof			42.28	0.11	4.65		(30)
Total area of external elements $\sum A$, m ²			129.33				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	36.96	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						181.10	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						5.98	(36)
Total fabric heat loss					(33) + (36) =	42.94	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)											
40.24	39.99	39.76	38.64	38.43	37.45	37.45	37.27	37.83	38.43	38.85	39.29

Heat transfer coefficient, W/K (37)m + (38)m												
83.18	82.94	82.70	81.58	81.37	80.39	80.39	80.21	80.77	81.37	81.79	82.24	
Average = $\sum(39)1...12/12 =$											81.58	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)												
0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.95	0.96	0.96	0.97	0.97	
Average = $\sum(40)1...12/12 =$											0.96	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N												2.54	{42}
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												94.61	{43}
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
104.07	100.29	96.51	92.72	88.94	85.15	85.15	88.94	92.72	96.51	100.29	104.07	
										$\sum(44)1...12 =$	1135.36	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
154.34	134.99	139.29	121.44	116.52	100.55	93.18	106.92	108.20	126.09	137.64	149.47	
										$\Sigma(45)1...12 =$	1488.63	(45)

Distribution loss 0.15 x (45)m												
23.15	20.25	20.89	18.22	17.48	15.08	13.98	16.04	16.23	18.91	20.65	22.42	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.13	12.75	14.08	13.58	14.01	13.52	13.95	13.98	13.55	14.05	13.64	14.12	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

168.47	147.74	153.37	135.02	130.53	114.07	107.12	120.91	121.75	140.14	151.28	163.58	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

168.47	147.74	153.37	135.02	130.53	114.07	107.12	120.91	121.75	140.14	151.28	163.58	
$\Sigma(64)1...12 =$											1653.99	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

54.85	48.07	49.83	43.77	42.25	36.81	34.47	39.05	39.36	45.44	49.18	53.23	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	152.62	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

57.61	51.16	41.61	31.50	23.55	19.88	21.48	27.92	37.48	47.59	55.54	59.21	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

341.35	344.90	335.97	316.97	292.98	270.43	255.37	251.83	260.76	279.76	303.75	326.29	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	52.81	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	-101.75	(71)
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Water heating gains (Table 5)

73.72	71.53	66.98	60.80	56.78	51.13	46.33	52.48	54.67	61.07	68.30	71.54	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

579.36	574.27	551.24	515.95	479.99	448.12	429.86	438.92	459.59	495.10	534.27	563.72	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 4.95	x 19.64	x 0.9 x 0.71	x 0.70	= 33.48	(80)
East	0.77	x 4.40	x 19.64	x 0.9 x 0.71	x 0.70	= 29.76	(76)

Solar gains in watts $\Sigma(74)m...(82)m$

63.25	123.73	203.76	297.17	364.20	372.82	354.94	304.89	236.98	146.81	78.86	52.01	(83)
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Total gains - internal and solar (73)m + (83)m

642.61	698.00	755.00	813.12	844.19	820.94	784.80	743.80	696.57	641.91	613.13	615.73	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.95	0.89	0.77	0.60	0.44	0.49	0.72	0.91	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.88	20.03	20.29	20.61	20.84	20.96	20.99	20.99	20.91	20.61	20.20	19.85	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.10	20.10	20.10	20.11	20.11	20.12	20.12	20.13	20.12	20.11	20.11	20.11	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.94	0.86	0.72	0.53	0.36	0.40	0.65	0.89	0.96	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.61	18.83	19.20	19.65	19.95	20.10	20.12	20.12	20.05	19.67	19.08	18.58	(90)
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Living area fraction

Living area ÷ (4) = 0.23 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.90	19.10	19.44	19.86	20.15	20.29	20.32	20.32	20.24	19.88	19.33	18.87	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.75	18.95	19.29	19.71	20.00	20.14	20.17	20.17	20.09	19.73	19.18	18.72	(93)
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5. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.96	0.92	0.85	0.72	0.53	0.36	0.40	0.65	0.87	0.95	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

623.04	667.02	697.24	690.42	605.28	432.31	284.93	299.10	451.06	559.74	583.35	599.62	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1201.97	1165.37	1057.96	882.26	675.77	445.57	286.85	302.14	484.12	742.96	988.30	1193.85	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

430.72	334.90	268.38	138.13	52.45	0.00	0.00	0.00	0.00	136.31	291.56	442.10	
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Σ(98)1...5, 10...12 = 2094.56 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 24.77 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

475.94	370.05	296.55	152.63	57.95	0.00	0.00	0.00	0.00	150.62	322.17	488.51	
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Σ(211)1...5, 10...12 = 2314.43 (211)

Water heating

Efficiency of water heater

89.58	89.50	89.31	88.89	88.19	87.30	87.30	87.30	87.30	88.85	89.38	89.61	(217)
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Water heating fuel, kWh/month

188.07	165.08	171.73	151.90	148.00	130.66	122.71	138.49	139.46	157.73	169.26	182.55	
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Σ(219a)1...12 = 1865.64 (219)

Annual totals

Space heating fuel - main system 1

2314.43

Water heating fuel

1865.64

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit

30.00

(230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	406.93	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4662.01 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2314.43	x	3.48	x 0.01 =	80.54	(240)
Water heating	1865.64	x	3.48	x 0.01 =	64.92	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	406.93	x	13.19	x 0.01 =	53.67	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		329.03	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.07	(257)
SAP value	85.12	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2314.43	x	0.216	=	499.92	(261)
Water heating	1865.64	x	0.216	=	402.98	(264)
Space and water heating			(261) + (262) + (263) + (264) =		902.90	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	406.93	x	0.519	=	211.20	(268)
Total CO ₂ , kg/year			(265)...(271) =		1153.02	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		13.64	(273)
EI value					88.07	
EI rating (section 14)					88	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2314.43	x	1.22	=	2823.60	(261)
Water heating	1865.64	x	1.22	=	2276.08	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5099.69	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	406.93	x	3.07	=	1249.29	(268)
Primary energy kWh/year					6579.23	(272)
Dwelling primary energy rate kWh/m ² /year					77.81	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B54F 00EC Type 54 EOT, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	50.43 (1a)	x	2.31 (2a)	=	116.49 (3a)
+1	50.43 (1b)	x	2.56 (2b)	=	129.10 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =				100.86 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =				245.59 (5)

2. Ventilation rate

		m ³ per hour	
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.12 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
Number of sides on which the dwelling is sheltered			3 (19)
Shelter factor	1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.29 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			13.97	1.24	17.26		(27)
Ground floor			50.43	0.13	6.56		(28a)
External wall			79.77	0.27	21.54		(29a)
Party wall			46.23	0.00	0.00		(32)
Roof			50.43	0.11	5.55		(30)
Total area of external elements $\sum A$, m ²			198.88				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	58.18	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						157.50	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						6.92	(36)
Total fabric heat loss					(33) + (36) =	65.10	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
46.02	45.80	45.60	44.61	44.43	43.57	43.57	43.42	43.90	44.43	44.80	45.19	(38)

Heat transfer coefficient, W/K (37)m + (38)m												
111.12	110.90	110.69	109.71	109.53	108.67	108.67	108.51	109.00	109.53	109.90	110.29	
Average = $\Sigma(39)1...12/12 =$											109.71	(39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)												
1.10	1.10	1.10	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.09	
Average = $\Sigma(40)1...12/12 =$											1.09	(40)

Number of days in month (Table 1a)												
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.75	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.45	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
109.39	105.42	101.44	97.46	93.48	89.50	89.50	93.48	97.46	101.44	105.42	109.39	
										$\Sigma(44)1...12 =$	1193.39	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
162.23	141.89	146.41	127.65	122.48	105.69	97.94	112.39	113.73	132.54	144.68	157.11	
										$\Sigma(45)1...12 =$	1564.73	(45)

Distribution loss 0.15 x (45)m												
24.33	21.28	21.96	19.15	18.37	15.85	14.69	16.86	17.06	19.88	21.70	23.57	(46)

Water storage loss calculated for each month (55) x (41)m												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(55)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c												
14.15	12.77	14.11	13.61	14.03	13.54	13.97	14.01	13.58	14.07	13.66	14.13	(61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

176.37	154.65	160.52	141.26	136.51	119.23	111.91	126.39	127.31	146.61	158.34	171.24	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

176.37	154.65	160.52	141.26	136.51	119.23	111.91	126.39	127.31	146.61	158.34	171.24	
$\Sigma(64)1...12 =$											1730.35	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

57.48	50.37	52.21	45.85	44.23	38.53	36.06	40.87	41.21	47.59	51.52	55.77	(65)
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5 Internal gains

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

Metabolic gains (Table 5)

164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

61.76	54.86	44.61	33.78	25.25	21.32	23.03	29.94	40.18	51.02	59.55	63.48	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

384.64	388.63	378.58	357.16	330.13	304.73	287.76	283.77	293.82	315.24	342.27	367.67	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	(71)
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Water heating gains (Table 5)

77.25	74.95	70.17	63.67	59.45	53.51	48.46	54.93	57.24	63.96	71.56	74.96	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

635.84	630.62	605.54	566.79	527.01	491.73	471.43	480.82	503.42	542.40	585.55	618.29	(73)
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6 Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
West	0.77	x 6.05	x 19.64	x 0.9	x 0.71	x 0.70	= 40.93 (80)
North	0.77	x 1.32	x 10.63	x 0.9	x 0.71	x 0.70	= 4.83 (74)
East	0.77	x 6.60	x 19.64	x 0.9	x 0.71	x 0.70	= 44.65 (76)

Solar gains in watts $\Sigma(74)m... (82)m$

90.41	176.63	291.38	427.27	526.70	540.77	514.16	439.43	339.50	209.63	112.66	74.40	(83)
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Total gains - internal and solar (73)m + (83)m

726.25	807.26	896.92	994.07	1053.72	1032.50	985.59	920.25	842.92	752.02	698.21	692.69	(84)
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7 Mean internal temperature (heating season)

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

												21.00 (85)
--	--	--	--	--	--	--	--	--	--	--	--	------------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.94	0.88	0.77	0.61	0.47	0.52	0.74	0.91	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.48	19.66	19.99	20.40	20.73	20.92	20.98	20.97	20.83	20.40	19.86	19.43	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.00	20.00	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.01	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.93	0.86	0.73	0.54	0.37	0.42	0.67	0.89	0.96	0.98	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.98	18.25	18.72	19.29	19.73	19.95	20.01	20.00	19.86	19.30	18.55	17.92	(90)
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Living area fraction

Living area ÷ (4) = 0.24 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.34	18.59	19.02	19.56	19.97	20.19	20.24	20.24	20.10	19.57	18.87	18.29	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.19	18.44	18.87	19.41	19.82	20.04	20.09	20.09	19.95	19.42	18.72	18.14	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.95	0.91	0.84	0.72	0.54	0.38	0.42	0.67	0.87	0.95	0.97	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

700.90	766.31	820.49	835.62	753.92	556.43	372.68	389.50	561.75	656.18	661.63	671.74	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1543.56	1501.81	1369.79	1153.37	889.34	590.82	379.54	399.97	637.33	965.97	1276.50	1537.46	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

626.94	494.26	408.68	228.78	100.75	0.00	0.00	0.00	0.00	230.48	442.71	644.09	
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Σ(98)1...5, 10...12 = 3176.70 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 31.50 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

692.75	546.14	451.58	252.80	111.33	0.00	0.00	0.00	0.00	254.67	489.18	711.70	
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Σ(211)1...5, 10...12 = 3510.17 (211)

Water heating

Efficiency of water heater

89.78	89.72	89.57	89.25	88.63	87.30	87.30	87.30	87.30	89.23	89.63	89.81	(217)
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Water heating fuel, kWh/month

196.46	172.38	179.21	158.27	154.02	136.58	128.19	144.78	145.83	164.31	176.65	190.68	
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Σ(219a)1...12 = 1947.34 (219)

Annual totals

Space heating fuel - main system 1

3510.17

Water heating fuel

1947.34

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	436.31	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5968.82 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3510.17	x	3.48	x 0.01 =	122.15	(240)
Water heating	1947.34	x	3.48	x 0.01 =	67.77	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	436.31	x	13.19	x 0.01 =	57.55	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	377.36	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.09	(257)
SAP value	84.84	
SAP rating (section 13)	85	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3510.17	x	0.216	=	758.20	(261)
Water heating	1947.34	x	0.216	=	420.63	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1178.82	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	436.31	x	0.519	=	226.44	(268)
Total CO ₂ , kg/year				(265)...(271) =	1444.19	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	14.32	(273)
EI value					86.73	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3510.17	x	1.22	=	4282.40	(261)
Water heating	1947.34	x	1.22	=	2375.76	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6658.16	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	436.31	x	3.07	=	1339.47	(268)
Primary energy kWh/year					8227.88	(272)
Dwelling primary energy rate kWh/m ² /year					81.58	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	21/10/2021
Address	B54F 00MC Type 54 Mid Terr, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	50.43 (1a)	x	2.31 (2a)	=	116.49 (3a)
+1	50.43 (1b)	x	2.56 (2b)	=	129.10 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		100.86 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		245.59 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
Air changes per hour			
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) =	0.12 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5.01 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor		1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.32 (21)
Infiltration rate modified for monthly wind speed:			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.40	0.39	0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			12.65	1.24	15.63		(27)
Ground floor			50.43	0.12	6.05		(28a)
External wall			34.86	0.27	9.41		(29a)
Party wall			92.46	0.00	0.00		(32)
Roof			50.43	0.11	5.55		(30)
Total area of external elements ΣA , m ²			152.65				(31)
Fabric heat loss, W/K = $\Sigma(A \times U)$					(26)...(30) + (32) =	43.92	(33)
Heat capacity Cm = $\Sigma(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						170.10	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Appendix K						6.49	(36)
Total fabric heat loss					(33) + (36) =	50.41	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
47.13	46.88	46.62	45.44	45.22	44.19	44.19	44.00	44.59	45.22	45.67	46.14	(38)

Heat transfer coefficient, W/K (37)m + (38)m	97.54	97.29	97.04	95.86	95.63	94.60	94.60	94.41	95.00	95.63	96.08	96.55	
Average = $\Sigma(39)1...12/12 =$	95.85												(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.97	0.96	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.95	0.95	0.96	
Average = $\Sigma(40)1...12/12 =$	0.95												(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.75												(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.45												(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	109.39	105.42	101.44	97.46	93.48	89.50	89.50	93.48	97.46	101.44	105.42	109.39	
$\Sigma(44)1...12 =$	1193.39												(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.23	141.89	146.41	127.65	122.48	105.69	97.94	112.39	113.73	132.54	144.68	157.11	
$\Sigma(45)1...12 =$	1564.73												(45)

Distribution loss 0.15 x (45)m	24.33	21.28	21.96	19.15	18.37	15.85	14.69	16.86	17.06	19.88	21.70	23.57	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c	14.15	12.77	14.11	13.61	14.03	13.54	13.97	14.01	13.58	14.07	13.66	14.13	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

176.37	154.65	160.52	141.26	136.51	119.23	111.91	126.39	127.31	146.61	158.34	171.24	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

176.37	154.65	160.52	141.26	136.51	119.23	111.91	126.39	127.31	146.61	158.34	171.24	
$\Sigma(64)1...12 =$											1730.35	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

57.48	50.37	52.21	45.85	44.23	38.53	36.06	40.87	41.21	47.59	51.52	55.77	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	164.84	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

63.13	56.07	45.60	34.52	25.81	21.79	23.54	30.60	41.07	52.15	60.87	64.89	(67)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

384.64	388.63	378.58	357.16	330.13	304.73	287.76	283.77	293.82	315.24	342.27	367.67	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	54.23	(69)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	-109.89	(71)
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Water heating gains (Table 5)

77.25	74.95	70.17	63.67	59.45	53.51	48.46	54.93	57.24	63.96	71.56	74.96	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

637.21	631.84	606.53	567.54	527.57	492.21	471.94	481.48	504.31	543.53	586.87	619.70	(73)
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6. Solar gains

Access factor
Table 6d

Area
m²

Solar flux
W/m²

g
specific data
or Table 6b

FF
specific data
or Table 6c

Gains
W

East $0.77 \times 6.05 \times 19.64 \times 0.9 \times 0.71 \times 0.70 = 40.93$ (76)

West $0.77 \times 6.60 \times 19.64 \times 0.9 \times 0.71 \times 0.70 = 44.65$ (80)

Solar gains in watts $\Sigma(74)m...(82)m$

85.57	167.40	275.68	402.06	492.74	504.40	480.21	412.50	320.62	198.63	106.70	70.37	(83)
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Total gains - internal and solar (73)m + (83)m

722.78	799.23	882.21	969.60	1020.31	996.61	952.15	893.97	824.93	742.16	693.57	690.07	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.94	0.88	0.75	0.58	0.43	0.47	0.71	0.91	0.97	0.99	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.80	19.97	20.25	20.59	20.84	20.96	20.99	20.99	20.91	20.58	20.13	19.77	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.11	20.11	20.12	20.12	20.13	20.14	20.14	20.14	20.13	20.13	20.12	20.12	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.93	0.85	0.71	0.51	0.35	0.39	0.64	0.88	0.96	0.98	(88)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.52	18.76	19.16	19.64	19.96	20.11	20.13	20.13	20.05	19.64	19.01	18.47	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.24 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.83	19.05	19.43	19.88	20.18	20.31	20.34	20.34	20.26	19.87	19.28	18.79	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.68	18.90	19.28	19.73	20.03	20.16	20.19	20.19	20.11	19.72	19.13	18.64	(93)
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5. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.97	0.95	0.92	0.84	0.70	0.51	0.35	0.40	0.64	0.87	0.95	0.97	(94)

Useful gains, ηmGm, W (94)m x (84)m

701.28	763.09	810.94	812.82	714.54	510.45	337.18	353.69	529.61	646.58	660.62	672.59	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1402.53	1362.33	1239.82	1037.67	796.26	526.34	339.64	357.65	570.92	871.96	1155.77	1393.99	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

521.73	402.69	319.09	161.90	60.80	0.00	0.00	0.00	0.00	167.68	356.51	536.73	
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Σ(98)1...5, 10...12 = 2527.12 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 25.06 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	90.50	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
576.50	444.96	352.58	178.89	67.18	0.00	0.00	0.00	0.00	185.29	393.93	593.07	
Σ(211)1...5, 10...12 =											2792.40	(211)

Water heating

Efficiency of water heater												
89.67	89.59	89.40	88.98	88.26	87.30	87.30	87.30	87.30	88.98	89.49	89.70	(217)
Water heating fuel, kWh/month												
196.69	172.62	179.55	158.75	154.67	136.58	128.19	144.78	145.83	164.77	176.93	190.90	
Σ(219a)1...12 =											1950.26	(219)

Annual totals

Space heating fuel - main system 1	2792.40
Water heating fuel	1950.26

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit 30.00 (230c)

boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	445.97	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5263.63 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2792.40	x	3.48	x 0.01 =	97.18	(240)
Water heating	1950.26	x	3.48	x 0.01 =	67.87	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	445.97	x	13.19	x 0.01 =	58.82	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		353.76	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.02	(257)
SAP value	85.79	
SAP rating (section 13)	86	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2792.40	x	0.216	=	603.16	(261)
Water heating	1950.26	x	0.216	=	421.26	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1024.41	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	445.97	x	0.519	=	231.46	(268)
Total CO ₂ , kg/year			(265)...(271) =		1294.80	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		12.84	(273)
EI value					88.10	
EI rating (section 14)					88	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2792.40	x	1.22	=	3406.73	(261)
Water heating	1950.26	x	1.22	=	2379.32	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5786.04	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	445.97	x	3.07	=	1369.14	(268)
Primary energy kWh/year					7385.43	(272)
Dwelling primary energy rate kWh/m ² /year					73.22	(273)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Andrew Maughan	Assessor number	11523
Client		Last modified	29/01/2021
Address	B55F 00EC Type 55 EOT, Barratt Developments plc		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	43.65 (1a)	x	2.31 (2a)	=	100.83 (3a)
+1	43.65 (1b)	x	2.56 (2b)	=	111.74 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		87.30 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		212.58 (5)

2. Ventilation rate

			m ³ per hour
Number of chimneys	0	x 40 =	0 (6a)
Number of open flues	0	x 20 =	0 (6b)
Number of intermittent fans	3	x 10 =	30 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	30	÷ (5) = 0.14 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.01 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.39 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] =	0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.30 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.39	0.38	0.37	0.33	0.33	0.29	0.29	0.28	0.30	0.33	0.34	0.36
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft

0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			4.28	1.70	7.28		(26)
Window			12.43	1.24	15.36		(27)
Ground floor			43.65	0.14	6.11		(28a)
External wall			81.91	0.27	22.12		(29a)
Party wall			37.30	0.00	0.00		(32)
Roof			43.65	0.11	4.80		(30)
Total area of external elements $\sum A$, m ²			185.92				(31)
Fabric heat loss, W/K = $\sum(A \times U)$					(26)...(30) + (32) =	55.66	(33)
Heat capacity Cm = $\sum(A \times \kappa)$					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K						169.80	(35)
Thermal bridges: $\sum(L \times \Psi)$ calculated using Appendix K						7.66	(36)
Total fabric heat loss					(33) + (36) =	63.32	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)												
40.33	40.12	39.92	38.98	38.81	37.99	37.99	37.84	38.31	38.81	39.16	39.54	(38)

Heat transfer coefficient, W/K (37)m + (38)m	103.65	103.44	103.24	102.30	102.13	101.31	101.31	101.16	101.63	102.13	102.48	102.86	
Average = $\sum(39)1...12/12 =$	102.30												(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.19	1.18	1.18	1.17	1.17	1.16	1.16	1.16	1.16	1.17	1.17	1.18	
Average = $\sum(40)1...12/12 =$	1.17												(40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
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4. Water heating energy requirement

Assumed occupancy, N	2.59											(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	95.64											(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.20	101.38	97.55	93.73	89.90	86.08	86.08	89.90	93.73	97.55	101.38	105.20	
$\sum(44)1...12 =$	1147.68												(44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	156.01	136.45	140.80	122.76	117.79	101.64	94.19	108.08	109.37	127.46	139.13	151.09	
$\sum(45)1...12 =$	1504.78												(45)

Distribution loss 0.15 x (45)m	23.40	20.47	21.12	18.41	17.67	15.25	14.13	16.21	16.41	19.12	20.87	22.66	(46)
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Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
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Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c	14.13	12.75	14.09	13.59	14.01	13.52	13.95	13.99	13.56	14.05	13.65	14.12	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

170.14	149.20	154.89	136.35	131.80	115.17	108.14	122.07	122.93	141.52	152.78	165.21	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

170.14	149.20	154.89	136.35	131.80	115.17	108.14	122.07	122.93	141.52	152.78	165.21	
$\Sigma(64)1...12 =$											1670.20	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

55.41	48.56	50.34	44.21	42.67	37.18	34.80	39.43	39.76	45.89	49.67	53.77	(65)
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5. Internal gains

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

Metabolic gains (Table 5)

155.22	155.22	155.22	155.22	155.22	155.22	155.22	155.22	155.22	155.22	155.22	155.22	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

55.75	49.52	40.27	30.49	22.79	19.24	20.79	27.02	36.27	46.05	53.75	57.30	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

349.29	352.91	343.78	324.33	299.79	276.72	261.31	257.68	266.82	286.26	310.81	333.87	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	53.11	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	(71)
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Water heating gains (Table 5)

74.47	72.26	67.66	61.41	57.35	51.63	46.78	53.00	55.22	61.69	68.99	72.27	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

587.36	582.54	559.56	524.08	487.77	455.44	436.72	445.56	466.15	501.85	541.40	571.29	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W	
East	0.77	x 3.85	x 19.64	x 0.9 x 0.71	x 0.70	= 26.04	(76)
North	0.77	x 6.38	x 10.63	x 0.9 x 0.71	x 0.70	= 23.37	(74)
West	0.77	x 2.20	x 19.64	x 0.9 x 0.71	x 0.70	= 14.88	(80)

Solar gains in watts $\Sigma(74)m... (82)m$

64.29	124.71	207.72	314.17	399.84	417.00	393.76	327.47	244.57	148.15	79.85	53.13	(83)
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Total gains - internal and solar (73)m + (83)m

651.65	707.25	767.28	838.24	887.61	872.44	830.49	773.02	710.72	650.00	621.25	624.43	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.96	0.91	0.81	0.66	0.51	0.56	0.78	0.93	0.97	0.98	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.44	19.60	19.91	20.32	20.67	20.89	20.97	20.96	20.79	20.34	19.82	19.41	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.94	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.95	0.89	0.77	0.58	0.40	0.45	0.71	0.91	0.97	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.87	18.11	18.55	19.13	19.60	19.87	19.94	19.93	19.76	19.18	18.44	17.83	(90)
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Living area fraction

Living area ÷ (4) = 0.18 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.15	18.38	18.79	19.34	19.79	20.05	20.12	20.11	19.95	19.39	18.69	18.11	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.00	18.23	18.64	19.19	19.64	19.90	19.97	19.96	19.80	19.24	18.54	17.96	(93)
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B. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.96	0.93	0.87	0.75	0.57	0.40	0.45	0.70	0.89	0.95	0.97	(94)
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Useful gains, ηmGm, W (94)m x (84)m

630.54	675.78	712.30	725.79	665.70	499.14	333.93	348.74	497.71	577.10	591.45	606.70	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1420.45	1378.69	1253.50	1052.89	811.29	537.16	341.49	360.36	578.93	882.03	1171.99	1415.32	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

587.69	472.35	402.66	235.51	108.32	0.00	0.00	0.00	0.00	226.87	417.98	601.61	
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Σ(98)1...5, 10...12 = 3053.00 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 34.97 (99)

5a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

90.50 (206)

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

Space heating fuel (main system 1), kWh/month

649.38	521.94	444.92	260.24	119.69	0.00	0.00	0.00	0.00	250.68	461.86	664.76	
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Σ(211)1...5, 10...12 = 3373.48 (211)

Water heating

Efficiency of water heater

89.76	89.71	89.59	89.30	88.72	87.30	87.30	87.30	87.30	89.24	89.62	89.79	(217)
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Water heating fuel, kWh/month

189.55	166.32	172.89	152.68	148.56	131.92	123.87	139.83	140.81	158.57	170.48	183.99	
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Σ(219a)1...12 = 1879.48 (219)

Annual totals

Space heating fuel - main system 1

3373.48

Water heating fuel

1879.48

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	393.84	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 5721.80	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3373.48	x	3.48	x 0.01 =	117.40	(240)
Water heating	1879.48	x	3.48	x 0.01 =	65.41	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	393.84	x	13.19	x 0.01 =	51.95	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	364.64	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.16	(257)
SAP value	83.85	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	3373.48	x	0.216	=	728.67	(261)
Water heating	1879.48	x	0.216	=	405.97	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1134.64	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	393.84	x	0.519	=	204.40	(268)
Total CO ₂ , kg/year				(265)...(271) =	1377.97	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	15.78	(273)
EI value					86.04	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3373.48	x	1.22	=	4115.64	(261)
Water heating	1879.48	x	1.22	=	2292.97	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6408.61	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	393.84	x	3.07	=	1209.08	(268)
Primary energy kWh/year					7847.94	(272)
Dwelling primary energy rate kWh/m ² /year					89.90	(273)