EPS Group
Energy Consultancy and Compliance Services

Project No: 15089

North Somerset Council

Energy Statement

Proposed New Dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX

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SAP Calculations – SBEM Calculations – Renewable Energy Statements – Energy Performance Certificates
Air Tightness Testing – Extract Fan Testing – Water Calculations – DEC Assessments - Room Integrity Testing

elmhurst accredited energy assessor · elmhurst energy APPROVED AIRTIGHTNESS SCHEME MEMBER · SAP · Constructionline Part of Capita plc · retrotec

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Issue Details:

Version	Date	Author	Details
1	21/10/2022	AB	Issued for submission
2	29/01/2024	AB	Re-issued for submission following design changes

Executive Summary

This report has been commissioned in response to the Sustainable and Low Carbon Planning Policy requirements of North Somerset Council in respect to the proposed construction of a new dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX.

The methodology used herein is consistent with Approved Document L1 2021 of the Building Regulations and the principles of the widely accepted Energy Hierarchy approach to improving the energy performance of new and existing buildings.

The statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of enhanced insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations.

Further improvements are then proposed through the installation of photovoltaic panels with a minimum output capacity of 3.735 kWp. This is expected to comprise of 9 x 415W panels being installed on the south east facing pitched roof and will require approx. 18 m^2 of the roof space.

Predictive SAP calculations for the proposed development firmly demonstrate that the dwelling will achieve a reduction in regulated CO_2 emissions of **1.88%** in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations, which is the equivalent to a **32.88%** improvement upon Part L1A 2013. Furthermore, it has also been demonstrated that **60.07%** of the proposed dwelling's annual regulated energy demand will be met through the installation of onsite renewable sources.

In light of the above, the proposal is deemed to be compliant with Policy CS2 of North Somerset Council's Core Strategy (2017), in respect to minor developments and moreover the Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development (2021).

Table of Contents

1.0 Introduction

1.1 EPS Group have been appointed to provide an Energy Statement to support the planning application for the proposed construction of a new dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX.

1.2 It is anticipated that if planning is approved, the development would fall under the requirements of Approved Document L1 (2021) of the Building Regulations.

1.3 The energy consumption of the development has therefore been assessed using the National Calculations Method (NCM) - SAP 10 (Standard Assessment Procedure), in order to determine the predicted annual carbon dioxide (CO_2) emissions of the dwellings and the associated reduction targets.

1.4 The following fuel emissions factors have been utilised within the supporting calculations as defined by the updated National Calculations Method (NCM):

Fuel	CO_2 emission factor ($kgCO_2/kWh$)
Natural gas	0.210
Grid supplied electricity	0.136
Grid displaced electricity	0.136

1.5 This document should be used for planning purposes only and should be reassessed and where necessary, resubmitted at the Building Control stage if alternative building specifications or proposed HVAC systems are adopted as oppose to those outlined within the report.

1.6 It is also highlighted that the SAP calculations utilised within the report rely on a number of standard operational parameters which may not ultimately match the actual measures adopted within the finalised dwellings. Whilst they provide a 'like for like' comparison for the purpose of this Energy Statement, they are not valid for Building Control applications or for the actual operation of the development post completion.

2.0 Planning Policy Context

2.1 National

The National Planning Policy Framework (NPPF) outlines the Government's planning policies for England and how these are expected to be applied by local authorities. Section 14 of this document details how local policies should address climate change through the promotion of energy efficiency and the adoption of low carbon and renewable technologies. It states:

"***14.0 Meeting the challenge of climate change, flooding and coastal change***

157. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and costal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

158. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

159. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

160. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

161. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

162. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

163. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas; and

c) in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of utilising an established site, and approve the proposal if its impacts are or can be made acceptable.

164. In determining planning applications, local planning authorities should give significant weight to the need to support energy efficiency and low carbon heating improvements to existing buildings, both domestic and non-domestic (including through installation of heat pumps and solar panels where these do not already benefit from permitted development rights). Where the proposals would affect conservation areas, listed buildings or other relevant designated heritage assets, local planning authorities should also apply the policies set out in chapter 16 of this Framework."

2.2 Local

"Policy CS2 – 'Delivering sustainable design and construction" of the *North Somerset Council's Core Strategy (January 2017)* states:

'New development both residential (including conversions) and non-residential should demonstrate a commitment to sustainable design and construction, increasing energy efficiency through design, and prioritising the use of sustainable low or zero carbon forms of renewable energy generation in order to increase the sustainability of the building stock across North Somerset.

The greatest potential for energy saving opportunities is likely to be at larger scale developments particularly at the Weston Villages and Weston town centre. In addition these areas are expected to demonstrate exemplar environmental standards contributing to the objectives of Policy CS1, and adding value to the local economy.

When considering proposals for development the council will:

1. *Require designs that are energy efficient and designed to reduce their energy demands;*

2. *Require the use of on-site renewable energy sources or by linking with/contributing to available local off-site renewable energy sources to meet a minimum of 10% of predicted energy use for residential development proposals involving one to nine dwellings, and 15% for 10 or more dwellings; and 10% for non-residential developments over 500m² and 15% for 1000m² and above;*

3. *Require as a minimum Code for Sustainable Homes Level 3 for all new dwellings from October 2010, Level 4 from 2013, rising to Level 6 by 2016. Higher standards will be encouraged ahead of this trajectory where scheme viability specifically supports this. BREEAM 'Very Good' will be required on all non-residential developments over 500m² and 'Excellent' over 1000m²;*

4. *Require all developments of 10 or more new homes to incorporate 50% constructed to the Lifetime Homes standard up to 2013 and 100% from 2013 onwards;*

5. *Require the application of best practice in Sustainable Drainage Systems to reduce the impact of additional surface water run-off from new development. Such environmental infrastructure should be integrated into the design of the scheme and into landscaping features, and be easily maintained. In moving towards zero carbon development, applicants will ensure that sustainable principles are established in the new proposals from the outset.*

In moving towards zero carbon development, applicants will ensure that sustainable principles are established in the new proposals from the outset."

The **'Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development'** *(revised version 2021)* provides detailed guidance on the implementation of policies for energy efficiency, renewable and low carbon energy generation and on Sustainable Drainage Systems (SuDS). It also contains information on measures that can be taken for future proofing design in a changing climate and the transition to zero carbon development.

The SPD was originally adopted in 2015 and has been revised as a result of the Council declaring a Climate Emergency in 2019 and in part states…:

"3. *In the same year that the Council adopted the original version of this SPD, the Government released the Housing Standard Review and the Written Ministerial Statement which withdrew the Code for Sustainable Homes and indicated that local planning authorities would be prevented from setting performance improvements for new residential development higher than those of Building Regulations.*

4. *As a direct result of these government policy statements, the Council provided a statement confirming that it would no longer seek Code for Sustainable Homes compliance for new residential development, apart for legacy cases1. This has meant that from the date of its statement, the Council has not required new residential development proposals to comply with performance standards in excess of those set out in Building Regulations. However, clarification on whether local planning authorities can set performance standards higher than Building Regulations, has subsequently been provided through Planning Practice Guidance.*

5. *In light of the NPPG clarification, the Council has reviewed its position and will now require Code for Sustainable Homes Level 4 equivalent improvement in performance standards in all new residential development applications, which will include the conversion of agricultural, industrial and commercial*

properties to residential use. This will apply to all new applications that are registered after the date that this updated SPD is adopted.

6. *Code for Sustainable Homes Level 4 was equivalent to a 19% improvement on the performance standards of Building Regulations 2013 – Part L1A: Conservation of Fuel and Power for new dwellings. Guidance on the documentation required to demonstrate compliance with this standard can be found in the checklist in Appendix 1.*

7 *In addition to this requirement, the Council will continue to require clause 2 of Policy CS2, which is for new residential development to provide between a minimum of 10% to 15% of the predicted energy use (depending on development size), to be met through renewable and low carbon energy generation – this is detailed in Section 4.*"

2.3 Conclusions

On review of the above planning policies and in particular the SPD that was originally adopted in 2015 and subsequently revised in 2021, it is evident that there should be no mandatory planning requirement to undertake a formal Code for Sustainable Homes Assessment.

It is however recognised that there is still a need to construct dwellings with an equivalent energy performance standard of Code for Sustainable Homes Level 4 and therefore the dwelling will need to reduce its carbon dioxide emissions by at least 19% in comparison to the standard requirements of Part L1A 2013 of the Building Regulations.

However, it should be noted that in June 2022, the Government implemented an interim uplift to Part L of the Building Regulations, updating the Building Regulations 2013. Dwellings conforming to the interim standard will be expected to produce 31% less CO_2 emissions compared to current standards set out in the 2013 Building Regulations. In reflection of this update to Part L of the Building Regulations, the equivalent energy performance standard of Code for Sustainable Homes Level 4 would be exceeded by developments complying with the latest version of Approved Document L1 2021.

Furthermore, as a minor development (less than 10 dwellings), the proposed development should also provide at least 10% of its predicted regulated energy consumption from decentralised, low carbon or renewable technologies.

3.0 Proposed Energy Strategy and Performance – Lean Measures

3.1 In accordance with the 'Lean' principles of the Energy Hierarchy, it is provisionally proposed to adopt the following minimum fabric, heating and lighting standards within the dwellings as a means of reducing the overall regulated energy demand prior to considering the use of low carbon or renewable technologies:

Table 1: Proposed 'Lean' Fabric Standards		
Element / Feature	**Current Approved Document L1 2021 Minimal Acceptable Standard**	**Proposed Development Target**
External Wall U-value	0.26 W/m^2K	**0.18 W/m^2K**
Ground Floor U-value	0.18 W/m^2K	**0.16 W/m^2K**
Cold Pitched Roof (Insulated at Joists) U-value	0.16 W/m^2K	**0.10 W/m^2K**
Glazing U-value	1.60 W/m^2K	**1.40 W/m^2K**
Air Permeability	8.00 $m^3/m^2.h$	**5.00 $m^3/m^2.h$**
Thermal Bridging	N/A	**Recognised Construction Details**
Proposed HVAC & Lighting Details		
Lighting	All fixed lighting to have an efficacy of 75 lm/W	**LED lighting with a luminous efficacy of 80 lm/W**
Boiler Efficiency (Gas Combi)	Min 88% Efficient (SEDBUK 2009)	**89.60% Efficient (Ideal Logic Combi ESP 1 24 or equivalent)**
Boiler Controls	Room Thermostat, Programmer & TRVs	**Delayed Start Time and Temperature Zone Control**
Ventilation	-	**Natural Ventilation with intermittent extract fans**

3.2 The above build standards will ensure that the proposed dwelling has a reduced energy demand in comparison to the minimum requirements of Approved Document L1 2021 of the Building Regulations. This will help to significantly reduce the associated CO_2 emissions arising from occupancy.

4.0 Proposed Energy Strategy and Performance – Green Measures

4.1 In response to the requirements of *Policy CS2* of the *North Somerset Council's Core Strategy (Adopted April 2017)* a number of different low carbon and renewable technologies were reviewed in terms of their overall suitability for use within the proposed development.

4.2 Wind Turbine (Column or Roof Mounted)

Benefits	• When installed in optimum positions, wind turbines can generate a large amount of renewable electricity, the surplus of which can be exported at financial gain to the national grid via the Smart Export Guarantee scheme.
Site Limitations / Restrictions	• Not aesthetically pleasing and will not be in keeping with the immediate local area. • The site is too sheltered as a result of its general urban location which would result in unreliable and insufficient outputs. • Require on-going maintenance which future occupants may neglect. • Can produce unacceptable levels of noise to occupants and neighbours.
Conclusion	• The technology is not deemed as being suitable for use within the proposed development.

4.3 Solar Photovoltaic

Benefits	• When installed in optimum positions photovoltaic (PV) arrays can generate a large amount of renewable electricity which can be used locally or exported at financial gain to the national grid via the Smart Export Guarantee scheme. • Minimal on-going costs & maintenance issues following installation. • Easy to integrate into a conventional build specification. • The dwelling benefits from a south east facing pitched roof space, which would facilitate the installation of panels at a near optimal pitch and orientation to ensure maximum efficiency and generation capacity.
Site Limitations / Restrictions	• PV panels are not always aesthetically pleasing and may detract from the visual appearance of the dwelling. • As a result of the rapid decarbonisation of the national grid, the amount of CO_2 savings with this technology is limited as the CO_2 emission factor for grid displaced electricity is relatively low.
Conclusion	• **It is proposed to utilise this technology within the proposed development.**

4.4 Solar Thermal

Benefits	• Solar hot water systems can provide an efficient way of contributing to a building's overall hot water requirements. • Minimal on-going costs & maintenance issues following installation. • As with PV, the collectors could be installed on the near optimal south east facing pitched roof space to maximise their efficiency.

Site Limitations / Restrictions	• The amount of CO_2 / useful energy savings with this technology is restricted as there is no benefit to producing more hot water than is used within a dwelling. • Not always aesthetically pleasing and may detract from the visual appearance of the dwelling. • Requires the installation of a hot water cylinder / thermal store which introduces another source of energy loss to the dwelling whilst also potentially restricting useable floor space.
Conclusion	• It is not proposed to use this technology within the proposed dwelling.

4.5 **Ground Source Heat Pump**

Benefits	• High operating efficiencies (CoPs). • Reliable and proven technology. • Generally low maintenance costs. • No visual impact on the development.
Site Limitations / Restrictions	• Detailed ground surveys required. • High capital installation costs potentially rendering the technology financially unviable. • Trench installations require significant areas of land and there is minimal space to facilitate an installation. • Requires the installation of a hot water cylinder / thermal store which introduces another source of energy loss to the dwelling whilst also potentially restricting useable floor space.
Conclusion	• The technology is not deemed as being suitable for use within the proposed development.

4.6 **Air Source Heat Pump**

Benefits	• High operating efficiencies (CoPs). • Reduced visual impact on the property. • Reliable and proven technology. • Generally low maintenance costs.
Site Limitations / Restrictions	• Often require supplementary immersion heating systems for hot water production. • Requires the installation of a hot water cylinder / thermal store which introduces another source of energy loss to the dwelling whilst also potentially restricting useable floor space. • The external compressors can result in some noise problems, although this can be limited through the careful selection of particular models with low acoustic levels of operation and the potential use of acoustic housing units.
Conclusion	• It is not proposed to use this technology within the proposed dwelling.

4.7 **Biomass Boilers**

Benefits	• Reliable and proven technology.
Site Limitations / Restrictions	• Require large storage facilities for the fuel. • On-going cleaning, maintenance and management requirements. • Require regular fuel deliveries. • Would contribute to poor urban air quality.
Conclusion	• The technology is not deemed as being suitable for use within the proposed development.

4.8 On review of the above technologies, the use of photovoltaic (PV) panels is recommended as being the most suitable and cost effective technology for use within the proposed development. This will provide a local source of renewable electricity for occupant use as well as a reduction in the calculated carbon dioxide emissions.

4.9 It is therefore provisionally proposed to install a PV array with a minimum total output capacity of 3.735 kWp. This is expected to comprise of 9 x 415W panels being installed on the south east facing pitched roof and will require approx. 18 m^2 of the roof space.

5.0 Calculated Energy Performance (Predicted)

5.1 A predicted SAP calculation has been produced for the dwelling based upon the proposed design parameters outlined within Section 3 of this report and the installation of a photovoltaic (PV) array with a minimum total output capacity of 3.735 kWp, as detailed in paragraph 4.9.

5.2 The results of the predicted SAP Calculation are summarised within the tables below with the full calculation Worksheets provided for detailed review within the Appendix to this report:

Table 2: Predicted Annual CO_2 Emissions (SAP 2012)		
Target Emission Rate (TER)	Dwelling Emission Rate (DER)	CO_2 Reduction
11.15	10.94	**1.88%**

Table 3: Predicted Domestic Annual Energy Consumption (kWh/Yr)				
(A) Space Heating (kWh/Yr)	(B) Hot Water (kWh/Yr)	(C) Auxiliary (kWh/Yr)	(D) Lighting (kWh/Yr)	(E) PV Generation (kWh/Yr)
2,234.98	2,644.39	86.00	154.23	-3,075.21
Total Regulated Energy Consumption (kWh/Year) (A)+(B)+(C)+(D)				**5,119.59**
Total Energy Produced via PV (kWh/Year) (E)				**-3,075.21**
Percentage Annual Energy Contribution via PV				**60.07%**

5.3 Upon review of the above, it is evident that the dwelling will achieve a reduction in regulated CO_2 emissions of **1.88%** in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations. Furthermore, it has also been demonstrated that **60.07%** of the proposed dwelling's annual regulated energy demand will be met through the installation of onsite renewable sources.

5.4 In light of the above, the proposal is deemed to be compliant with Policy CS2 of North Somerset Council's Core Strategy (2017), in respect to minor developments and moreover the Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development (2021).

Appendix 1:

Full SAP Calculation Printout

Full SAP Calculation Printout

Property Reference	15089	Issued on Date	29/01/2024
Assessment Reference	00001	Prop Type Ref	
Property	32 , Falcon Crescent, Weston Super Mare, BS22 8RX		

SAP Rating	98 A	DER	10.94	TER	11.15
Environmental	92 A	% DER < TER			1.88
CO_2 Emissions (t/year)	0.5	DFEE	40.42	TFEE	42.15
Compliance Check	See BREL	% DFEE < TFEE			4.10
% DPER < TPER	1.36	DPER	58.77	TPER	59.58

Assessor Details	Mr. Andrew Bamford	Assessor ID	F391-0001
Client			

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

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                                                                         Area        Storey height              Volume
                                                                         (m2)             (m)                    (m3)
Ground floor                                                          60.7200 (1b)   x      2.3800 (2b)   =    144.5136 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          60.7200                                                  (4)
Dwelling volume                                                         (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    144.5136 (5)
```

2. Ventilation rate

```
                                                                                                              m3 per hour

Number of open chimneys                                                                                0 * 80 =      0.0000 (6a)
Number of open flues                                                                                   0 * 20 =      0.0000 (6b)
Number of chimneys / flues attached to closed fire                                                     0 * 10 =      0.0000 (6c)
Number of flues attached to solid fuel boiler                                                          0 * 20 =      0.0000 (6d)
Number of flues attached to other heater                                                               0 * 35 =      0.0000 (6e)
Number of blocked chimneys                                                                             0 * 20 =      0.0000 (6f)
Number of intermittent extract fans                                                                    2 * 10 =     20.0000 (7a)
Number of passive vents                                                                                0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                           0 * 40 =      0.0000 (7c)

                                                                                                       Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =        20.0000 / (5) =      0.1384 (8)
Pressure test                                                                                                            Yes
Pressure Test Method                                                                                              Blower Door
Measured/design AP50                                                                                                 5.0000 (17)
Infiltration rate                                                                                                    0.3884 (18)
Number of sides sheltered                                                                                                 2 (19)

Shelter factor                                                            (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                              (21) = (18) x (20)   =      0.3301 (21)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4209	0.4127	0.4044	0.3631	0.3549	0.3136	0.3136	0.3054	0.3301	0.3549	0.3714	0.3879	(22b)
Effective ac	0.5886	0.5851	0.5818	0.5659	0.5630	0.5492	0.5492	0.5466	0.5545	0.5630	0.5690	0.5752	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.40)			12.8300	1.3258	17.0095			(27)
Heatloss Floor 1			60.7200	0.1600	9.7152			(28a)
External Wall 1	76.7300	12.8300	63.9000	0.1800	11.5020			(29a)
External Roof 1	60.7200		60.7200	0.1000	6.0720			(30)
Total net area of external elements Aum(A, m2)			198.1700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.2987			(33)

```
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                  250.0000 (35)
List of Thermal Bridges
```

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	8.8200	0.0260	0.2293
E3 Sill	8.8200	0.0230	0.2029
E4 Jamb	20.6000	0.0180	0.3708
E5 Ground floor (normal)	32.2400	0.0480	1.5475
E16 Corner (normal)	9.5200	0.0400	0.3808
E10 Eaves (insulation at ceiling level)	20.2400	0.0550	1.1132
E12 Gable (insulation at ceiling level)	12.0000	0.0370	0.4440

```
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                          4.2885 (36)
Point Thermal bridges                                                                             (36a) =      0.0000
Total fabric heat loss                                                              (33) + (36) + (36a) =     48.5872 (37)
```

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.0695	27.9054	27.7446	26.9893	26.8480	26.1902	26.1902	26.0684	26.4436	26.8480	27.1339	27.4328	(38)
Heat transfer coeff	76.6566	76.4926	76.3318	75.5765	75.4352	74.7774	74.7774	74.6555	75.0307	75.4352	75.7211	76.0199	(39)
Average = Sum(39)m / 12 =												75.5758	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2625	1.2598	1.2571	1.2447	1.2423	1.2315	1.2315	1.2295	1.2357	1.2423	1.2471	1.2520	(40)
HLP (average)												1.2447	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0019 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	79.4546	78.2605	76.5206	73.1915	70.7347	67.9949	66.4376	68.1644	70.0572	72.9990	76.3996	79.1501	(42a)
Hot water usage for baths	24.9727	24.6018	24.0796	23.1166	22.3955	21.5960	21.1641	21.6827	22.2474	23.1029	24.0858	24.8883	(42b)
Hot water usage for other uses	35.1316	33.8541	32.5766	31.2991	30.0216	28.7441	28.7441	30.0216	31.2991	32.5766	33.8541	35.1316	(42c)
Average daily hot water use (litres/day)												128.3460	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.5589	136.7165	133.1767	127.6071	123.1518	118.3349	116.3457	119.8686	123.6037	128.6785	134.3394	139.1701	(44)
Energy conte	221.0272	194.6825	204.6877	174.6878	165.7859	145.5066	140.7101	148.4224	152.4158	174.6155	191.3912	217.9067	(45)
Energy content (annual)										Total = Sum(45)m =		2131.8393	
Distribution loss (46)m = 0.15 x (45)m	33.1541	29.2024	30.7032	26.2032	24.8679	21.8260	21.1065	22.2634	22.8624	26.1923	28.7087	32.6860	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	16.5514	14.9288	16.4828	15.8528	16.3194	15.7302	16.2141	16.2464	15.7592	16.3565	15.9229	16.5383	(61)
Total heat required for water heating calculated for each month	237.5786	209.6113	221.1704	190.5406	182.1053	161.2368	156.9241	164.6689	168.1750	190.9720	207.3141	234.4450	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	237.5786	209.6113	221.1704	190.5406	182.1053	161.2368	156.9241	164.6689	168.1750	190.9720	207.3141	234.4450	(64)
								Total per year (kWh/year) = Sum(64)m =				2324.7421	(64)
12Total per year (kWh/year)												2325	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	77.6294	68.4641	72.1793	62.0469	59.2037	52.3135	50.8396	53.4121	54.6181	62.1488	67.6183	76.5886	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	88.3507	97.8169	88.3507	91.2958	88.3507	91.2958	88.3507	88.3507	91.2958	88.3507	91.2958	88.3507	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	174.7591	176.5725	172.0027	162.2740	149.9934	138.4513	130.7404	128.9270	133.4968	143.2255	155.5061	167.0482	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	(71)
Water heating gains (Table 5)	104.3406	101.8811	97.0152	86.1762	79.5748	72.6576	68.3328	71.7904	75.8584	83.5333	93.9143	102.9416	(72)
Total internal gains	423.4792	432.2993	413.3974	395.7748	373.9477	355.4334	340.4527	342.0969	353.6797	371.1383	396.7450	414.3693	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0300	11.2829	0.6300	0.7000	0.7700	17.3445	(75)
Southeast	4.6600	36.7938	0.6300	0.7000	0.7700	52.4002	(77)
Southwest	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	105.0530	184.7052	268.0244	357.7447	424.1157	431.3467	411.5787	360.4886	298.8472	208.2646	126.8784	89.2246	(83)
Total gains	528.5321	617.0045	681.4218	753.5195	798.0633	786.7801	752.0314	702.5855	652.5269	579.4028	523.6234	503.5939	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.0072	55.1252	55.2413	55.7934	55.8979	56.3896	56.3896	56.4816	56.1992	55.8979	55.6868	55.4679	
alpha	4.6671	4.6750	4.6828	4.7196	4.7265	4.7593	4.7593	4.7654	4.7466	4.7265	4.7125	4.6979	
util living area	0.9905	0.9799	0.9577	0.8946	0.7683	0.5846	0.4327	0.4804	0.7191	0.9242	0.9809	0.9923	(86)
MIT	19.6910	19.9149	20.2134	20.5828	20.8466	20.9675	20.9936	20.9898	20.9157	20.5676	20.0652	19.6526	(87)

```
Th 2           19.8704    19.8725    19.8746    19.8844    19.8863    19.8949    19.8949    19.8965    19.8916    19.8863    19.8825    19.8786 (88)
util rest of house
                0.9874     0.9736     0.9443     0.8626     0.7061     0.4935     0.3265     0.3694     0.6302     0.8936     0.9738     0.9898 (89)
MIT 2          18.3793    18.6630    19.0359    19.4832    19.7660    19.8778    19.8930    19.8932    19.8395    19.4792    18.8631    18.3364 (90)
Living area fraction                                                                             fLA = Living area / (4) =            0.2273 (91)
MIT            18.6774    18.9475    19.3035    19.7331    20.0116    20.1255    20.1432    20.1424    20.0841    19.7265    19.1363    18.6356 (92)
Temperature adjustment                                                                                                               -0.1500
adjusted MIT   18.5274    18.7975    19.1535    19.5831    19.8616    19.9755    19.9932    19.9924    19.9341    19.5765    18.9863    18.4856 (93)
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8. Space heating requirement
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                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9822     0.9654     0.9333     0.8524     0.7046     0.5005     0.3361     0.3793     0.6339     0.8830     0.9659     0.9853 (94)
Useful gains  519.1106   595.6821   635.9843   642.2869   562.3211   393.7495   252.7766   266.5019   413.6496   511.6068   505.7589   496.1967 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1090.6246  1063.0595   965.8675   807.3902   615.6684   401.9650   253.7332   268.1930   437.7377   677.1471   900.0405  1085.9874 (97)
Space heating kWh
              425.2064   314.0776   245.4331   118.8744    39.6904     0.0000     0.0000     0.0000     0.0000   123.1620   283.8828   438.8043 (98a)
Space heating requirement - total per year (kWh/year)                                                                              1989.1310
Solar heating kWh
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (98b)
Solar heating contribution - total per year (kWh/year)                                                                                0.0000
Space heating kWh
              425.2064   314.0776   245.4331   118.8744    39.6904     0.0000     0.0000     0.0000     0.0000   123.1620   283.8828   438.8043 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                     1989.1310
Space heating per m2                                                                                          (98c) / (4) =          32.7591 (99)
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9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                     89.0000 (206)
Efficiency of main space heating system 2 (in %)                                                                                      0.0000 (207)
Efficiency of secondary/supplementary heating system, %                                                                               0.0000 (208)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
              425.2064   314.0776   245.4331   118.8744    39.6904     0.0000     0.0000     0.0000     0.0000   123.1620   283.8828   438.8043 (98)
Space heating efficiency (main heating system 1)
               89.0000    89.0000    89.0000    89.0000    89.0000     0.0000     0.0000     0.0000     0.0000    89.0000    89.0000    89.0000 (210)
Space heating fuel (main heating system)
              477.7600   352.8962   275.7676   133.5667    44.5959     0.0000     0.0000     0.0000     0.0000   138.3842   318.9694   493.0385 (211)
Space heating efficiency (main heating system 2)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (212)
Space heating fuel (main heating system 2)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (213)
Space heating fuel (secondary)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
              237.5786   209.6113   221.1704   190.5406   182.1053   161.2368   156.9241   164.6689   168.1750   190.9720   207.3141   234.4450 (64)
Efficiency of water heater                                                                                                           87.3000 (216)
(217)m         88.3831    88.3117    88.1860    87.9454    87.5994    87.3000    87.3000    87.3000    87.3000    87.9587    88.2745    88.4005 (217)
Fuel for water heating, kWh/month
              268.8056   237.3540   250.7999   216.6578   207.8841   184.6928   179.7527   188.6241   192.6403   217.1155   234.8517   265.2076 (219)
Space cooling fuel requirement
(221)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (221)
Pumps and Fa    7.3041     6.5973     7.3041     7.0685     7.3041     7.0685     7.3041     7.3041     7.0685     7.3041     7.0685     7.3041 (231)
Lighting       19.1096    15.3304    13.8033    10.1129     7.8115     6.3821     7.1259     9.2625    12.0311    15.7855    17.8297    19.6407 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m       -45.2498   -61.5062   -85.1002   -90.8848   -93.4619   -85.6503   -84.5905   -82.0523   -76.5558   -68.3028   -48.8337   -39.2797 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m       -37.0724   -79.6189  -163.5966  -251.8810  -336.2569  -338.9105  -333.5171  -279.4537  -200.2473  -114.5336   -49.5911   -29.0630 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1                                                                                                 2234.9786 (211)
Space heating fuel - main system 2                                                                                                    0.0000 (213)
Space heating fuel - secondary                                                                                                        0.0000 (215)
Efficiency of water heater                                                                                                           87.3000
Water heating fuel used                                                                                                            2644.3861 (219)
Space cooling fuel                                                                                                                    0.0000 (221)

Electricity for pumps and fans:
   central heating pump                                                                                                              41.0000 (230c)
   main heating flue fan                                                                                                             45.0000 (230e)
Total electricity for the above, kWh/year                                                                                            86.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                 154.2253 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                                     -3075.2099 (233)
Wind generation                                                                                                                       0.0000 (234)
Hydro-electric generation (Appendix N)                                                                                                0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)                                                                                        0.0000 (235)
Appendix Q - special features
Energy saved or generated                                                                                                            -0.0000 (236)
Energy used                                                                                                                           0.0000 (237)
Total delivered energy for all uses                                                                                                2044.3801 (238)
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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2234.9786	0.2100	469.3455	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2644.3861	0.2100	555.3211	(264)
Space and water heating			1024.6666	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	154.2253	0.1443	22.2595	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-861.4680	0.1356	-116.8334	
PV Unit electricity exported	-2213.7419	0.1253	-277.4745	
Total			-394.3080	(269)
Total CO2, kg/year			664.5474	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.9400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2234.9786	1.1300	2525.5258	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2644.3861	1.1300	2988.1563	(278)
Space and water heating			5513.6821	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	154.2253	1.5338	236.5558	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-861.4680	1.5013	-1293.3171	
PV Unit electricity exported	-2213.7419	0.4601	-1018.4798	
Total			-2311.7969	(283)
Total Primary energy kWh/year			3568.5419	(286)
Dwelling Primary energy Rate (DPER)			58.7700	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	60.7200 (1b)	x	2.3800 (2b)	=	144.5136	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 60.7200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	144.5136	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1384	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3884	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3301	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4209	0.4127	0.4044	0.3631	0.3549	0.3136	0.3136	0.3054	0.3301	0.3549	0.3714	0.3879	(22b)
Effective ac	0.5886	0.5851	0.5818	0.5659	0.5630	0.5492	0.5492	0.5466	0.5545	0.5630	0.5690	0.5752	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			12.8300	1.1450	14.6908			(27)
Heatloss Floor 1			60.7200	0.1300	7.8936			(28a)
External Wall 1	76.7300	12.8300	63.9000	0.1800	11.5020			(29a)
External Roof 1	60.7200		60.7200	0.1100	6.6792			(30)
Total net area of external elements Aum(A, m2)			198.1700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.7656			(33)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	8.8200	0.0500	0.4410
E3 Sill	8.8200	0.0500	0.4410
E4 Jamb	20.6000	0.0500	1.0300
E5 Ground floor (normal)	32.2400	0.1600	5.1584
E16 Corner (normal)	9.5200	0.0900	0.8568
E10 Eaves (insulation at ceiling level)	20.2400	0.0600	1.2144
E12 Gable (insulation at ceiling level)	12.0000	0.0600	0.7200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8616 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 50.6272 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.0695	27.9054	27.7446	26.9893	26.8480	26.1902	26.1902	26.0684	26.4436	26.8480	27.1339	27.4328	(38)
Heat transfer coeff	78.6967	78.5327	78.3719	77.6166	77.4753	76.8174	76.8174	76.6956	77.0708	77.4753	77.7611	78.0600	(39)

Average = Sum(39)m / 12 = 77.6159

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2961	1.2934	1.2907	1.2783	1.2759	1.2651	1.2651	1.2631	1.2693	1.2759	1.2807	1.2856	(40)
HLP (average)												1.2783	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0019 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	57.7851	56.9167	55.6513	53.2302	51.4434	49.4508	48.3182	49.5741	50.9507	53.0901	55.5633	57.5637	(42a)
Hot water usage for baths	24.9727	24.6018	24.0796	23.1166	22.3955	21.5960	21.1641	21.6827	22.2474	23.1029	24.0858	24.8883	(42b)
Hot water usage for other uses	35.1316	33.8541	32.5766	31.2991	30.0216	28.7441	28.7441	30.0216	31.2991	32.5766	33.8541	35.1316	(42c)

Average daily hot water use (litres/day) 108.3675 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.8895	115.3727	112.3075	107.6458	103.8605	99.7908	98.2264	101.2784	104.4972	108.7697	113.5032	117.5837	(44)
Energy conte	186.7082	164.2892	172.6124	147.3618	139.8162	122.7045	118.7963	125.4038	128.8555	147.5995	161.7061	184.1076	(45)

Energy content (annual) Total = Sum(45)m = 1799.9610

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	28.0062	24.6434	25.8919	22.1043	20.9724	18.4057	17.8194	18.8106	19.3283	22.1399	24.2559	27.6161	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.2119	50.0551	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	237.6671	210.3166	223.5713	196.6768	190.7751	171.9164	168.8514	176.3627	178.1706	198.5584	211.0212	235.0665	(62)
WWHRS	-26.4170	-23.3634	-24.4648	-20.2578	-18.8795	-16.1554	-15.1431	-16.1031	-16.7150	-19.7051	-22.3235	-25.9278	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	211.2501	186.9532	199.1066	176.4190	171.8955	155.7610	153.7083	160.2595	161.4556	178.8533	188.6977	209.1388	(64)

Total per year (kWh/year) = Sum(64)m = 2153.4987 (64)
12Total per year (kWh/year) 2153 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	74.8202	66.1330	70.1334	61.3266	59.2286	53.1022	52.0135	54.4365	55.1732	61.8165	66.0960	73.9555	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	88.3507	97.8169	88.3507	91.2958	88.3507	91.2958	88.3507	88.3507	91.2958	88.3507	91.2958	88.3507	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	174.7591	176.5725	172.0027	162.2740	149.9934	138.4513	130.7404	128.9270	133.4968	143.2255	155.5061	167.0482	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	33.0096	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	(71)
Water heating gains (Table 5)	100.5648	98.4122	94.2653	85.1758	79.6083	73.7531	69.9107	73.1673	76.6295	83.0868	91.8001	99.4026	(72)
Total internal gains	419.7033	428.8304	410.6474	394.7743	373.9812	356.5289	342.0306	343.4738	354.4508	370.6917	394.6307	410.8303	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0300	11.2829	0.6300	0.7000	0.7700	17.3445	(75)
Southeast	4.6600	36.7938	0.6300	0.7000	0.7700	52.4002	(77)
Southwest	3.1400	36.7938	0.6300	0.7000	0.7700	35.3083	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	105.0530	184.7052	268.0244	357.7447	424.1157	431.3467	411.5787	360.4886	298.8472	208.2646	126.8784	89.2246	(83)
Total gains	524.7563	613.5356	678.6718	752.5191	798.0968	787.8756	753.6093	703.9624	653.2980	578.9563	521.5091	500.0549	(84)

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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau            53.5812     53.6932     53.8033     54.3269     54.4260     54.8921     54.8921     54.9792     54.7116     54.4260     54.2259     54.0183
alpha           4.5721      4.5795      4.5869      4.6218      4.6284      4.6595      4.6595      4.6653      4.6474      4.6284      4.6151      4.6012
util living area
                0.9909      0.9809      0.9599      0.8998      0.7779      0.5960      0.4425      0.4910      0.7293      0.9278      0.9818      0.9926 (86)

MIT            19.6341     19.8601     20.1653     20.5479     20.8279     20.9618     20.9922     20.9876     20.9044     20.5365     20.0190     19.5958 (87)
Th 2           19.8439     19.8460     19.8481     19.8579     19.8597     19.8683     19.8683     19.8698     19.8650     19.8597     19.8560     19.8522 (88)
util rest of house
                0.9880      0.9749      0.9470      0.8685      0.7155      0.5022      0.3318      0.3755      0.6392      0.8979      0.9749      0.9902 (89)
MIT 2          18.2886     18.5752     18.9571     19.4219     19.7243     19.8482     19.8660     19.8659     19.8057     19.4223     18.7862     18.2457 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.2273 (91)
MIT            18.5944     18.8672     19.2317     19.6778     19.9751     20.1013     20.1220     20.1208     20.0554     19.6755     19.0664     18.5526 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT   18.5944     18.8672     19.2317     19.6778     19.9751     20.1013     20.1220     20.1208     20.0554     19.6755     19.0664     18.5526 (93)


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8. Space heating requirement
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                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation     0.9834      0.9679      0.9382      0.8627      0.7224      0.5223      0.3571      0.4018      0.6557      0.8920      0.9684      0.9863 (94)
Useful gains  516.0620    593.8681    636.7535    649.1875    576.5302    411.5166    269.0803    282.8439    428.3504    516.4069    505.0311    493.2152 (95)
Ext temp.       4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000 (96)
Heat loss rate W
             1124.9251   1096.8812    997.8045    836.5353    641.1159    422.5966    270.5507    285.3722    458.9901    703.1258    930.5193   1120.3610 (97)
Space heating kWh
              452.9942    338.0248    268.6219    134.8904     48.0518      0.0000      0.0000      0.0000      0.0000    138.9189    306.3515    466.5965 (98a)
Space heating requirement - total per year (kWh/year)                                                                          2154.4499
Solar heating kWh
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (98b)
Solar heating contribution - total per year (kWh/year)                                                                          0.0000
Space heating kWh
              452.9942    338.0248    268.6219    134.8904     48.0518      0.0000      0.0000      0.0000      0.0000    138.9189    306.3515    466.5965 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                 2154.4499
Space heating per m2                                                                                       (98c) / (4) =      35.4817 (99)


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9a. Energy requirements - Individual heating systems, including micro-CHP
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Fraction of space heat from secondary/supplementary system (Table 11)                                                           0.0000 (201)
Fraction of space heat from main system(s)                                                                                      1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                               92.4000 (206)
Efficiency of main space heating system 2 (in %)                                                                                0.0000 (207)
Efficiency of secondary/supplementary heating system, %                                                                         0.0000 (208)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Space heating requirement
              452.9942    338.0248    268.6219    134.8904     48.0518      0.0000      0.0000      0.0000      0.0000    138.9189    306.3515    466.5965 (98)
Space heating efficiency (main heating system 1)
               92.4000     92.4000     92.4000     92.4000     92.4000      0.0000      0.0000      0.0000      0.0000     92.4000     92.4000     92.4000 (210)
Space heating fuel (main heating system)
              490.2535    365.8277    290.7163    145.9853     52.0041      0.0000      0.0000      0.0000      0.0000    150.3451    331.5492    504.9745 (211)
Space heating efficiency (main heating system 2)
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (212)
Space heating fuel (main heating system 2)
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (213)
Space heating fuel (secondary)
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (215)

Water heating
Water heating requirement
              211.2501    186.9532    199.1066    176.4190    171.8955    155.7610    153.7083    160.2595    161.4556    178.8533    188.6977    209.1388 (64)
Efficiency of water heater                                                                                                     80.3000 (216)
(217)m         85.9718     85.6340     85.0237     83.8132     82.0337     80.3000     80.3000     80.3000     80.3000     83.8459     85.4132     86.0478 (217)
Fuel for water heating, kWh/month
              245.7204    218.3167    234.1777    210.4908    209.5425    193.9739    191.4176    199.5760    201.0655    213.3119    220.9233    243.0495 (219)
Space cooling fuel requirement
(221)m          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (221)
Pumps and Fa    7.3041      6.5973      7.3041      7.0685      7.3041      7.0685      7.3041      7.3041      7.0685      7.3041      7.0685      7.3041 (231)
Lighting       18.3575     14.7271     13.2601      9.7149      7.5041      6.1309      6.8455      8.8980     11.5576     15.1643     17.1280     18.8678 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m       -47.6617    -63.0269    -85.0883    -89.7398    -92.1421    -84.4889    -83.4809    -81.0072    -76.0619    -69.1641    -50.9143    -41.7198 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m       -41.2443    -84.5861   -164.2517   -241.3075   -314.0349   -313.6724   -309.9172   -264.5977   -196.9707   -118.9876    -54.3958    -32.7763 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m         0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1                                                                                           2331.6558 (211)
Space heating fuel - main system 2                                                                                              0.0000 (213)
Space heating fuel - secondary                                                                                                  0.0000 (215)
Efficiency of water heater                                                                                                     80.3000
Water heating fuel used                                                                                                      2581.5659 (219)
Space cooling fuel                                                                                                              0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year                                                                                      86.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                           148.1559 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                               -3001.2381 (233)
```

Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2146.1394	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2331.6558	0.2100	489.6477	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2581.5659	0.2100	542.1288	(264)
Space and water heating			1031.7765	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	148.1559	0.1443	21.3835	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-864.4959	0.1359	-117.5193	
PV Unit electricity exported	-2136.7423	0.1266	-270.4360	
Total			-387.9553	(269)
Total CO2, kg/year			677.1340	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2331.6558	1.1300	2634.7710	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2581.5659	1.1300	2917.1695	(278)
Space and water heating			5551.9405	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	148.1559	1.5338	227.2464	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-864.4959	1.5025	-1298.8908	
PV Unit electricity exported	-2136.7423	0.4646	-992.7504	
Total			-2291.6412	(283)
Total Primary energy kWh/year			3617.6464	(286)
Target Primary Energy Rate (TPER)			59.5800	(287)