

Project No: 18521

North Hertfordshire District Council

Energy & Sustainability Statement

The Bothy Outbuilding Conversion, Hexton Manor, Hexton, Hertfordshire, SG5 3JH

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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



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Executive Summary

This report has been commissioned in response to the Sustainable and Low Carbon Planning Policy requirements of North Hertfordshire District Council in respect to the proposed conversion of the Bothy outbuilding at Hexton Manor, Hexton, Hertfordshire, SG5 3JH.

In accordance with the widely accepted Energy Hierarchy approach to energy conservation, this statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of enhanced insulation standards and improved HVAC & lighting efficiencies in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations.

A predictive SAP 10 calculation firmly demonstrates that the proposed dwelling is predicted to emit at least **35.82%** less carbon dioxide than would ordinarily be permitted by the standard requirements of Approved Document L1 2021 of the Building Regulations.

This reduction is achieved through the adoption of enhanced insulation standards, improved heating and lighting efficiencies, together with the installation of an MCS Approved NIBE Air Source Heat Pump as a means of providing the dwelling's heating and hot water from a low carbon source.

Asides from targeting improved energy efficiency, the proposed dwelling will also incorporate a number of water saving features to ensure a maximum calculated water consumption of 110 litres per person per day.

In the circumstances, the proposed development is deemed to satisfy the mandatory planning requirements of Policy D1 of North Hertfordshire Council's Local Plan (November 2022).

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1.0 Introduction

- 1.1 EPS Group have been appointed to provide an Energy and Sustainability Statement to support the planning application for the conversion of the Bothy outbuilding at Hexton Manor, Hexton, Hertfordshire, SG5 3JH.
- 1.2 The planning application relates to the conversion of an existing building and it is therefore anticipated that the proposed dwelling will need to comply with the requirements of Approved Document L1 2021 of the Building Regulations, if planning is permitted.
- 1.3 The energy consumption of the proposed dwelling has therefore been assessed using the National Calculations Method (NCM) - SAP 10 (Standard Assessment Procedure), in order to determine the predicted annual carbon dioxide (CO₂) emissions of the development 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:

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 report 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 dwelling. Whilst they provide a 'like for like' comparison for the purpose of this report, they are not valid for Building Control applications or for the actual operation of the development post completion.
- 1.7 The dimensions that are referenced within this report are based upon SAP measurement conventions which may result in slight differences with other dimensions quoted elsewhere.

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:

157. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal 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.

Planning for climate change

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 North Hertfordshire District Council

Policy D1: Sustainable Design of North Hertfordshire Council's *Local Plan* (November 2022) requires buildings to be designed in order reduce energy consumption and to have a positive influence on the environment. It encourages development to seek to minimise carbon emissions and maximise opportunities for energy generation from renewable sources. Specifically, the policy states:

"Planning permission will be granted provided that development proposals:

- a) *Respond positively to the site's local context;*
- b) *Take all reasonable opportunities, consistent with the nature and scale of the scheme, to:*
 - i. *create or enhance public realm;*
 - ii. *optimise the potential of the site by incorporating Sustainable Drainage Systems (SuDS);*
 - iii. *reduce energy consumption and waste;*
 - iv. *retain existing vegetation and propose appropriate new planting;*
 - v. *maximise accessibility, legibility and physical and social connectivity both internally and with neighbouring areas;*
 - vi. *future proof for changes in technology and lifestyle;*
 - vii. *design-out opportunities for crime and anti-social behaviour; and*
 - viii. *minimise the visual impact of street furniture and parking provision;*
- c) *Have regard to the Design SPD, and any other relevant guidance;*

- d) *Within Letchworth Garden City have regard to the Letchworth Garden City Design Principles contained in Appendix 5; and*
- e) *For residential schemes, meet or exceed the nationally described space standards and optional water efficiency standards."*

Of further relevance is supporting Paragraph 9.12 which states:

"Development proposals should be in line with current regulations and guidelines and any future changes in Legislation or to the Building Regulations that will affect the sustainability of a building. North Hertfordshire lies in an area of serious water stress. Both the Environment Agency and Anglian Water support the introduction of the optional water efficiency standard within the district therefore, the lower figure of 110 litres per person per day for water consumption is sought. The introduction of the lower standard will have a marginal impact on scheme viability in the area."

2.3 Conclusions

On review of the above planning policies, it is evident that there is a requirement for development to consider the use of increased energy efficiency standards and low carbon / renewable technology as part of an overall energy strategy.

The proposed development will therefore minimise regulated carbon dioxide (CO₂) emissions in comparison to those allowable under the current edition of Approved Document L1 2021 by following the widely accepted energy hierarchy approach to energy conservation in new and existing dwellings.

It is also recognised that there is an ongoing requirement to reduce internal water consumption to achieve a minimum water efficiency of 110 litres per person per day.

3.0 Proposed Energy Strategy and Performance

- 3.1 The proposed dwelling benefits from a range of passive design features including an internal layout that facilitates natural cross ventilation which should act to reduce overheating risks during the summer months and reduce the likelihood of any future occupants installing mechanical cooling.
- 3.2 In accordance with the 'Lean' principles of the Energy Hierarchy, the following minimum fabric, heating and lighting standards will be adopted within the dwelling as a means of reducing its overall energy demand by conventional (lean) means:

Table 1: Proposed Fabric and Lighting Standards		
Element / Feature	Current Approved Document L1 2021 Minimal Acceptable Standard	Proposed Development Target
Existing External Wall U-value (thermally upgraded)	0.30 W/m ² K	0.26 W/m²K
New External Wall U-value	0.26 W/m ² K	0.18 W/m²K
Existing Ground Floor U-value (thermally upgraded)	0.25 W/m ² K	0.15 W/m²K
New Ground Floor U-value	0.18 W/m ² K	0.14 W/m²K
Pitched Roof U-value – Insulated @ Rafters	0.15 W/m ² K	0.15 W/m²K
Pitched Roof U-value – Insulated @ Joists	0.15 W/m ² K	0.14 W/m²K
Glazing U-value	1.40 W/m ² K	1.20 W/m²K
Entrance Door U-value (Half Glazed)	1.40 W/m ² K	1.00 W/m²K
Lighting	All fixed lighting to have an efficacy of 75 lm/W	All fixed lighting to have an efficacy of 80 lm/W
Primary Heating & Hot Water	-	MCS Approved Air Source Heat Pump to Zoned Underfloor Heating (NIBE S2125-8 or equivalent)
Hot Water Storage	-	210 litre Hot Water Storage Cylinder with 2.30 kWh / day Standby Loss
Ventilation	-	Natural Ventilation with Intermittent Extract Fans

- 3.3 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 reduce the overall energy consumption and the associated CO₂ emissions arising from occupancy.
- 3.4 It is noted that the dwelling has been designed to maximise the amount of natural daylight available, which in conjunction with the highly efficient LED lighting proposed will significantly reduce the amount of energy consumed through artificial lighting.

4.0 Review of Low Carbon and Renewable Technologies:

4.1 In response to the 'Green' requirement of the Energy Hierarchy a number of different renewable technologies were reviewed in terms of their overall suitability for inclusion 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 local area. - The site is sheltered by the surrounding trees 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 or retro-fit applications. - The dwelling benefits from south facing pitched roof space, which would provide an optimal location to install PV panels to maximise their efficiency and generation capacity.
Site Limitations / Restrictions	- PV panels are not aesthetically pleasing and may detract from the visual appearance of the dwelling. - The surrounding trees are likely to create overshadowing issues which would have a detrimental impact upon the efficiency and generation capacity of PV panels. - As a result of the rapid decarbonisation of the national grid, the amount of CO₂ savings with this technology is limited as the CO₂ emission factor for grid displaced electricity is relatively low.
Conclusion	The technology is not deemed as being suitable for use within the proposed development.

4.4 Solar Thermal

Benefits	- Solar hot water systems can provide an efficient way of contributing to a dwelling's overall hot water requirements. - Minimal on-going costs & maintenance issues following installation. - The south facing pitched roof space would provide an optimal location for the siting of a small number of solar collectors with an optimum orientation to maximise their efficiency.
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Site Limitations / Restrictions	- The amount of CO₂ savings with this technology is restricted as there is no benefit to producing more hot water than is used within a dwelling. - Solar collectors are not aesthetically pleasing and may detract from the visual appearance of the dwelling. - As with PV, the surrounding trees are likely to create overshadowing issues which would have a detrimental impact upon the efficiency of the solar collectors.
Conclusion	The technology is not deemed as being suitable for use within the proposed development.

4.5 Ground Source Heat Pump

Benefits	- High operating efficiencies (CoPs). - Flexible installation options including trench and borehole installations. - Reliable and proven technology. - Generally low maintenance costs. - No visual impact on the property.
Site Limitations / Restrictions	- Detailed ground surveys required. - High capital installation costs potentially rendering the technology financially unviable. - Trench installations require significant areas of land.
Conclusion	It is not proposed to use this technology 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 a supplementary immersion heating system for the generation of hot water. - The external units can result in some noise related problems although this can be limited through the careful selection of particular models with low operating acoustic levels and the potential use of acoustic housing units.
Conclusion	It is proposed to use this technology within the proposed dwelling (as detailed in Section 3).

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 installation of an MCS Approved Air Source Heat Pump (ASHP) is recommended as a means of providing the dwelling with a decentralised source of low carbon heating and hot water. This will provide an affordable and significant reduction in the development's energy consumption and associated carbon dioxide emissions.

4.9 The heat pump and hot water system will be designed, tested and commissioned to current approved standards.

5.0 Calculated Energy Performance (Illustrative)

- 5.1 Having identified the use of an Air Source Heat Pump as being the most suitable low carbon technology for use within the dwelling, a predictive SAP 10 calculation has been prepared for the development based upon the 'Lean' specifications outlined within Section 3 of this report, including an Air Source Heat Pump (NIBE S2125-8) as a primary source of heating and hot water.
- 5.2 The results of the illustrative SAP Calculation are summarised within Table 2 below with the full calculations provided within the Appendix 1 of this report for detailed review.

Table 2: Annual Regulated CO ₂ Emissions					
Floor Area (m ²)	Target Emission Rate (TER)	Annual Regulated 'Baseline' CO ₂ Emissions (Kg / Year)	Dwelling Emission Rate (DER)	Annual Regulated Proposed CO ₂ Emissions (Kg / Year)	Annual Percentage Reduction in CO ₂ Emissions
91.08	11.25	1,024.20	7.22	657.36	35.82%

- 5.3 On review of the above, it is evident that the proposed dwelling will achieve a minimum reduction in regulated CO₂ emissions of **35.82%** in comparison to Approved Document L1 2021 of the Building Regulations.

6.0 Flood Risk and Water Management

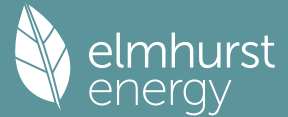
- 6.1 The dwelling will be designed to be water efficient and to avoid excessive potable water consumption through the specification of water saving appliances such as a reduced volume / dual flush cistern and through restricting the flow rates of the water outlets. This will provide an overall reduced water consumption of less than or equal to 110 litres per person per day in line with the national technical standard set out in Part G of the Building Regulations.
- 6.2 Whilst the precise specification for achieving the above water consumption target will be determined at the detailed design stage if planning permission is granted, an example specification is detailed below:
- Toilet = 4l (Full) and 2.6l (Part)
 - Basin mixer tap = 5l/min
 - Shower = 8/min
 - Bath = 170 litres capacity to overflow
 - Kitchen mixer tap = 6l/min
- 6.3 In addition to the above, the following measures will also be incorporated into the dwelling as means of encouraging future occupants to reduce their water consumption by raising awareness:
- Water meter installed in a readily visible location
 - Information on how to use water efficiently will be provided as part of any handover to future occupants
- 6.4 It is also noted that upon referencing the Environment Agency's Flood Risk Map, the proposed dwelling is located in an area that is not at risk of flooding.
- 6.5 In the circumstances, the proposed development is deemed to satisfy the mandatory planning requirements of Policy D1 of North Hertfordshire Council's Local Plan (November 2022).



Appendix 1:

Full SAP 10 Calculation Printout

Full SAP Calculation Printout



Property Reference	The Bothy				Issued on Date	26/03/2024
Assessment Reference	00001		Prop Type Ref			
Property	The Bothy, Hexton Manor, Hexton, SG5 3JH					
SAP Rating	69 C	DER	7.22	TER	11.25	
Environmental	94 A	% DER < TER				35.82
CO ₂ Emissions (t/year)	0.6	DFEE	95.79	TFEE	53.02	
Compliance Check	See BREL	% DFEE < TFEE				-80.65
% DPER < TPER	-23.93	DPER	75.14	TPER	60.63	
Assessor Details	Mr. Kian Donoghue				Assessor ID	CR84-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	91.0800	3.1600	287.8128
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.0800		
Dwelling volume			

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.0695 (8)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.8195 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8195 (21)

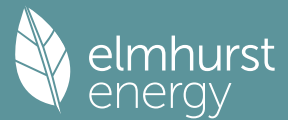
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	1.0448	1.0244	1.0039	0.9014	0.8810	0.7785	0.7785	0.7580	0.8195	0.8810	0.9219	0.9629 (22b)
Effective ac	1.0448	1.0244	1.0039	0.9063	0.8880	0.8030	0.8030	0.7873	0.8358	0.8880	0.9250	0.9636 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
window (Uw = 1.20)			12.7100	1.1450	14.5534		(27)
door			2.1000	1.0000	2.1000		(26a)
Existing Floor			97.4400	0.1500	14.6160		(28a)
New Heatloss Floor			18.6100	0.1400	2.6054		(28a)
New External Wall	33.4400	7.6000	25.8400	0.1800	4.6512		(29a)
Existing External Wall	73.8100	7.2100	66.6000	0.2600	17.3160		(29a)
pitched roof at rafters	51.9100		51.9100	0.1500	7.7865		(30)
pitched roof at ceiling	45.2200		45.2200	0.1400	6.3308		(30)
Total net area of external elements Aum(A, m ²)			320.4300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	69.9593	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							64.0860 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	134.0453 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	99.2379	97.2921	95.3462	86.0784	84.3442	76.2716	76.2716	74.7767	79.3811	84.3442	87.8524	91.5199 (38)
Heat transfer coeff												

Full SAP Calculation Printout



Average = Sum(39)m / 12 =	233.2833	231.3374	229.3916	220.1237	218.3896	210.3169	210.3169	208.8220	213.4264	218.3896	221.8977	225.5653 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	2.5613	2.5399	2.5186	2.4168	2.3978	2.3091	2.3091	2.2927	2.3433	2.3978	2.4363	2.4766 (40)
HLP (average)												2.4166
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.6402 (42)
Hot water usage for mixer showers													
94.1703	92.7551	90.6929	86.7472	83.8354	80.5882	78.7424	80.7891	83.0325	86.5191	90.5495	93.8095	(42a)	
Hot water usage for baths													
29.5751	29.1359	28.5173	27.3769	26.5229	25.5760	25.0645	25.6787	26.3475	27.3607	28.5247	29.4751	(42b)	
Hot water usage for other uses													
41.6685	40.1532	38.6380	37.1228	35.6076	34.0924	34.0924	35.6076	37.1228	38.6380	40.1532	41.6685	(42c)	
Average daily hot water use (litres/day)												152.1231 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.4139	162.0442	157.8483	151.2469	145.9659	140.2565	137.8993	142.0754	146.5028	152.5178	159.2274	164.9531 (44)	
Energy content (annual)	261.9751	230.7488	242.6069	207.0494	196.4982	172.4618	166.7773	175.9190	180.6526	206.9652	226.8486	258.2767 (45)	
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		2526.7796	
39.2963	34.6123	36.3910	31.0574	29.4747	25.8693	25.0166	26.3878	27.0979	31.0448	34.0273	38.7415 (46)		
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												2.3000 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.2420 (55)	
Total storage loss													
38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020 (56)		
If cylinder contains dedicated solar storage													
38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020 (57)		
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624 (59)		
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)		
Total heat required for water heating calculated for each month													
323.7395	286.5360	304.3713	266.8214	258.2626	232.2338	228.5417	237.6834	240.4246	268.7296	286.6206	320.0411 (62)		
WWHRS	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 (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 (63c)		
FGHRS	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													
323.7395	286.5360	304.3713	266.8214	258.2626	232.2338	228.5417	237.6834	240.4246	268.7296	286.6206	320.0411 (64)		
12Total per year (kWh/year)												3254.0056 (64)	
Electric shower(s)												3254 (64)	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)		
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)	
Heat gains from water heating, kWh/month													
136.5183	121.3537	130.0783	116.6615	114.7472	105.1611	104.8650	107.9046	107.8846	118.2275	123.2448	135.2885 (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	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.5274	144.5125	130.5274	134.8784	130.5274	134.8784	130.5274	130.5274	134.8784	130.5274	134.8784	130.5274 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.0507	243.5520	237.2487	223.8297	206.8905	190.9702	180.3344	177.8330	184.1363	197.5554	214.4945	230.4149 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087 (71)
Water heating gains (Table 5)	183.4923	180.5859	174.8364	162.0299	154.2301	146.0571	140.9475	145.0330	149.8397	158.9079	171.1733	181.8394 (72)
Total internal gains	617.6736	631.2537	605.2158	583.3412	554.2513	534.5089	514.4126	515.9967	531.4577	549.5939	583.1494	605.3850 (73)

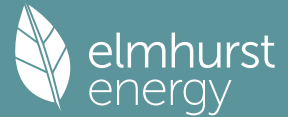
6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				4.2000	10.6334	0.6300	0.7000	0.7700	13.6488 (74)			
East				1.5000	19.6403	0.6300	0.7000	0.7700	9.0035 (76)			
South				4.0000	46.7521	0.6300	0.7000	0.7700	57.1522 (78)			
West				3.0100	19.6403	0.6300	0.7000	0.7700	18.0670 (80)			
Solar gains	97.8714	172.6395	250.7629	333.1401	392.2049	397.3748	379.8078	334.7687	279.2691	194.8421	118.3360	83.0244 (83)
Total gains	715.5450	803.8933	855.9787	916.4812	946.4562	931.8837	894.2204	850.7655	810.7267	744.4361	701.4854	688.4094 (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	10.8452	10.9364	11.0292	11.4935	11.5848	12.0295	12.0295	12.1156	11.8542	11.5848	11.4017	11.2163
alpha	1.7230	1.7291	1.7353	1.7662	1.7723	1.8020	1.8020	1.8077	1.7903	1.7723	1.7601	1.7478
util living area	0.9555	0.9438	0.9278	0.8948	0.8431	0.7534	0.6541	0.6822	0.8096	0.9025	0.9420	0.9581 (86)
Living	16.2447	16.5845	17.2091	18.1644	19.0936	19.9803	20.4608	20.3953	19.7193	18.5271	17.2913	16.2614

Full SAP Calculation Printout



Non living	13.9337	14.3522	15.1214	16.3015	17.4184	18.4471	18.9158	18.8733	18.1714	16.7604	15.2410	13.9631
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	25	0	0	0	0	0	0	0	0	0	0	0
16 / 9	6	28	31	0	0	0	0	0	0	0	6	31
MIT	20.4843	18.5252	18.8746	18.1644	19.0936	19.9803	20.4608	20.3953	19.7193	18.5271	17.6166	18.3416 (87)
Th 2	18.9854	18.9977	19.0100	19.0699	19.0813	19.1352	19.1352	19.1453	19.1143	19.0813	19.0583	19.0346 (88)
util rest of house												
	0.9460	0.9316	0.9107	0.8668	0.7917	0.6506	0.4723	0.5131	0.7265	0.8708	0.9274	0.9492 (89)
MIT 2	18.5440	16.9012	17.2555	16.3015	17.4184	18.4471	18.9158	18.8733	18.1714	16.7604	15.6604	16.7475 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	19.1838	17.4366	17.7893	16.9157	17.9707	18.9526	19.4252	19.3751	18.6818	17.3429	16.3054	17.2731 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1838	17.4366	17.7893	16.9157	17.9707	18.9526	19.4252	19.3751	18.6818	17.3429	16.3054	17.2731 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9471	0.9189	0.8970	0.8194	0.7496	0.6374	0.5079	0.5399	0.7000	0.8262	0.8944	0.9386 (94)
Useful gains	677.6638	738.7275	767.7829	750.9548	709.4708	593.9505	454.2143	459.3473	567.4771	615.0293	627.4134	646.1232 (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	3472.1305	2900.1920	2589.6811	1764.4484	1369.4585	915.4288	594.1933	621.2682	977.8717	1472.5763	2042.6503	2948.8420 (97)
Space heating kWh	2079.0832	1452.5041	1355.4923	729.7154	491.0309	0.0000	0.0000	0.0000	0.0000	638.0150	1018.9706	1713.2228 (98a)
Space heating requirement - total per year (kWh/year)												9478.0343
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	2079.0832	1452.5041	1355.4923	729.7154	491.0309	0.0000	0.0000	0.0000	0.0000	638.0150	1018.9706	1713.2228 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9478.0343
Space heating per m2										(98c) / (4) =		104.0627 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												377.9055 (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	2079.0832	1452.5041	1355.4923	729.7154	491.0309	0.0000	0.0000	0.0000	0.0000	638.0150	1018.9706	1713.2228 (98)
Space heating efficiency (main heating system 1)	377.9055	377.9055	377.9055	377.9055	377.9055	0.0000	0.0000	0.0000	0.0000	377.9055	377.9055	377.9055 (210)
Space heating fuel (main heating system)	550.1596	384.3565	358.6855	193.0947	129.9348	0.0000	0.0000	0.0000	0.0000	168.8293	269.6364	453.3469 (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	323.7395	286.5360	304.3713	266.8214	258.2626	232.2338	228.5417	237.6834	240.4246	268.7296	286.6206	320.0411 (64)
Efficiency of water heater (217)m	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000	193.2000 (216)
Fuel for water heating, kWh/month	167.5670	148.3106	157.5421	138.1063	133.6763	120.2038	118.2928	123.0245	124.4434	139.0940	148.3544	165.6527 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	27.1210	21.7575	19.5902	14.3526	11.0864	9.0577	10.1134	13.1457	17.0750	22.4033	25.3045	27.8748 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2508.0436 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												193.2000
Water heating fuel used												1684.2679 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												218.8822 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												4411.1937 (238)

Full SAP Calculation Printout



12a. Carbon dioxide 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	2508.0436	0.1549	388.3873	(261)
Total CO ₂ associated with community systems			0.0000	(373)
Water heating (other fuel)	1684.2679	0.1409	237.3770	(264)
Space and water heating			625.7643	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	218.8822	0.1443	31.5915	(268)
Total CO ₂ , kg/year			657.3558	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			7.2200	(273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year	
Space heating - main system 1	2508.0436	1.5733	3945.8834	(275)
Total CO ₂ associated with community systems			0.0000	(473)
Water heating (other fuel)	1684.2679	1.5211	2562.0056	(278)
Space and water heating			6507.8890	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	218.8822	1.5338	335.7288	(282)
Total Primary energy kWh/year			6843.6178	(286)
Dwelling Primary energy Rate (DPER)			75.1400	(287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)	
Ground floor	91.0800	(1b) x 3.1600 (2b)	= 287.8128	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.0800			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 287.8128	(5)

2. Ventilation rate

		m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1042 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3542	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3542	(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	0.4516	0.4428	0.4339	0.3897	0.3808	0.3365	0.3365	0.3277	0.3542	0.3808	0.3985	0.4162	(22b)
Effective ac	0.6020	0.5980	0.5942	0.5759	0.5725	0.5566	0.5566	0.5537	0.5627	0.5725	0.5794	0.5866	(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
TER Semi-glazed door			2.1000	1.0000	2.1000			(26a)
TER Opening Type (Uw = 1.20)			12.7100	1.1450	14.5534			(27)
Existing Floor			97.4400	0.1300	12.6672			(28a)
New Heatloss Floor			18.6100	0.1300	2.4193			(28a)
New External Wall	33.4400	7.6000	25.8400	0.1800	4.6512			(29a)
Existing External Wall	73.8100	7.2100	66.6000	0.1800	11.9880			(29a)
pitched roof at rafters	51.9100		51.9100	0.1100	5.7101			(30)
pitched roof at ceiling	45.2200		45.2200	0.1100	4.9742			(30)
Total net area of external elements Aum(A, m ²)			320.4300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.0634			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							16.0215	(36)

$$(33) + (36) + (36a) = 75.0849 \quad (37)$$
[illegible]

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	139.7311	136.7474	133.1138	127.5886	123.1017	118.2780	116.4241	120.0420	123.8576	128.9217	134.5321	139.3687 (44)
Energy conte	221.2998	194.7264	204.5910	174.6624	165.7186	145.4365	140.8049	148.6371	152.7288	174.9455	191.6656	218.2176 (45)
Energy content (annual)										Total =	Sum(45)m =	2133.4343

[illegible]

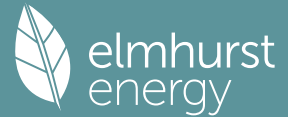
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	273.0464	241.4653	256.3376	224.7397	217.4651	195.5139	192.5515	200.3837	202.8061	226.6921	241.7430	269.9642	(62)
WWHRS	-31.3096	-27.6905	-28.9959	-24.0097	-22.3762	-19.1475	-17.9477	-19.0856	-19.8107	-23.3547	-26.4580	-30.7298	(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													
	241.7368	213.7748	227.3417	200.7300	195.0889	176.3664	174.6038	181.2981	182.9954	203.3374	215.2850	239.2344	(64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64a)m =												(64)
Electric shower(s)												2451.7927	(64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains from water heating, kWh/month													(64a)
	114.9795	102.1376	109.4238	98.1371	96.4987	88.4195	88.2149	90.8191	90.8442	99.5667	103.7907	113.9546	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108	132.0108 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.5274	144.5125	130.5274	134.8784	130.5274	134.8784	130.5274	130.5274	134.8784	130.5274	134.8784	130.5274 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.0507	243.5520	237.2487	223.8297	206.8905	190.9702	180.3344	177.8330	184.1363	197.5554	214.4945	230.4149 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011	36.2011 (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)	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087	-105.6087 (71)
Water heating gains (Table 5)	154.5423	151.9905	147.0750	136.3015	129.7025	122.8049	118.5684	122.0687	126.1725	133.8262	144.1537	153.1648 (72)
Total internal gains	591.7237	605.6583	580.4544	560.6128	532.7238	511.2567	492.0335	493.0324	507.7904	527.5122	559.1298	579.7104 (73)

[Jan]											Area		Solar flux		g		FF		Access		Gains	
											m2	Table 6a	or Table 6b	Specific data	Specific data	or Table 6c	factor	Table 6d	W			
												W/m2										
North											4.2000	10.6334	0.6300		0.7000	0.7700		13.6488	(74)			
East											1.5000	19.6403	0.6300		0.7000	0.7700		9.0035	(76)			
South											4.0000	46.7521	0.6300		0.7000	0.7700		57.1522	(78)			
West											3.0100	19.6403	0.6300		0.7000	0.7700		18.0670	(80)			
Solar gains	97.8714	172.6395	250.7629	333.1401	392.2049	397.3748	379.8078	334.7687	279.2691	194.8421	118.3360		83.0244	(83)								
Total gains	689.5950	778.2978	831.2173	893.7529	924.9287	908.6314	871.8412	827.8011	787.0595	722.3543	677.4658		662.7348	(84)								

Temperature during heating periods in the living area from Table 9, T_{h1} (C)	21.0000 (85)
Utilisation factor for gains for living area, $u_{l,m}$ (see Table 9a)	

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	19.1288	19.1834	19.2372	19.4939	19.5426	19.7730	19.7730	19.8163	19.6836	19.5426	19.4442	19.3423
alpha	2.2753	2.2789	2.2825	2.2996	2.3028	2.3182	2.3182	2.3211	2.3122	2.3028	2.2963	2.2895
util living area	0.9502	0.9332	0.9093	0.8604	0.7828	0.6616	0.5374	0.5728	0.7386	0.8733	0.9317	0.9542 (86)
MIT	17.8515	18.1648	18.6609	19.3617	20.0178	20.5520	20.8056	20.7671	20.3726	19.5356	18.5959	17.8120 (87)
Th 2	19.7236	19.7267	19.7298	19.7443	19.7470	19.7596	19.7596	19.7620	19.7547	19.7470	19.7415	19.7358 (88)
util rest of house	0.9422	0.9225	0.8939	0.8346	0.7375	0.5816	0.4183	0.4572	0.6698	0.8447	0.9189	0.9468 (89)
MIT 2	16.1093	16.5052	17.1310	18.0092	18.8027	19.4119	19.6551	19.6279	19.2289	18.2398	17.0633	16.0651 (90)
Living area fraction	16.1093	16.5052	17.1310	18.0092	18.8027	19.4119	19.6551	19.6279	19.2289	18.2398	17.0633	16.0651 (90)
MIT	16.6837	17.0524	17.6354	18.4552	19.2033	19.7878	20.0344	20.0035	19.6060	18.6670	17.5686	16.6410 (92)
Temperature adjustment	16.6837	17.0524	17.6354	18.4552	19.2033	19.7878	20.0344	20.0035	19.6060	18.6670	17.5686	16.6410 (93)
adjusted MIT	16.6837	17.0524	17.6354	18.4552	19.2033	19.7878	20.0344	20.0035	19.6060	18.6670	17.5686	16.6410 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9141	0.8906	0.8594	0.8009	0.7141	0.5836	0.4471	0.4822	0.6602	0.8126	0.8877	0.9200 (94)
Useful gains	630.3311	693.1421	714.3333	715.8374	660.5147	530.3164	389.8061	399.1308	519.6276	587.0000	601.3662	609.7394 (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	1637.8842	1602.7169	1464.4905	1240.1119	971.3841	663.7881	439.4418	460.0728	707.7013	1044.3623	1362.1368	1627.3025 (97)
Space heating kWh	749.6195	611.2343	558.1169	377.4776	231.2868	0.0000	0.0000	0.0000	0.0000	340.2776	547.7548	757.0669 (98a)
Space heating requirement - total per year (kWh/year)												4172.8343
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	749.6195	611.2343	558.1169	377.4776	231.2868	0.0000	0.0000	0.0000	0.0000	340.2776	547.7548	757.0669 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4172.8343
Space heating per m2										(98c) / (4) =		45.8150 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		92.3000 (206)
Efficiency of main space heating system 2 (in %)		0.0000 (207)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	749.6195	611.2343	558.1169	377.4776	231.2868	0.0000	0.0000	0.0000	0.0000	340.2776	547.7548	757.0669 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	812.1555	662.2257	604.6770	408.9681	250.5816	0.0000	0.0000	0.0000	0.0000	368.6647	593.4505	820.2242 (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	241.7368	213.7748	227.3417	200.7300	195.0889	176.3664	174.6038	181.2981	182.9954	203.3374	215.2850	239.2344 (64)
Efficiency of water heater (217)m	86.4233	86.2786	85.9929	85.4542	84.4425	79.8000	79.8000	79.8000	79.8000	85.2055	86.0615	79.8000 (216)
Fuel for water heating, kWh/month	279.7127	247.7727	264.3726	234.8978	231.0318	221.0105	218.8017	227.1906	229.3176	238.6434	250.1525	276.7041 (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 (221)
Lighting	27.1210	21.7575	19.5902	14.3526	11.0864	9.0577	10.1134	13.1457	17.0750	22.4033	25.3045	27.8748 (232)

Electricity generated by PVs (Appendix M) (negative quantity)	-69.1580	-90.3254	-120.3730	-125.1587	-126.9558	-115.7336	-114.2509	-111.5947	-106.0285	-98.1174	-73.4131	-60.6683 (233a)
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Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
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Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
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Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
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Electricity generated by PVs (Appendix M) (negative quantity)	-64.2011	-131.0942	-253.6371	-371.4122	-482.3097	-481.5083	-475.8463	-406.8127	-303.5204	-184.1101	-84.5521	-51.0759 (233b)
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Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
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Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
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Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
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Annual totals kWh/year												
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Space heating fuel - main system 1												4520.9473 (211)
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Space heating fuel - main system 2												0.0000 (213)
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Space heating fuel - secondary												0.0000 (215)
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Efficiency of water heater												79.8000
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Water heating fuel used												2919.6079 (219)
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Space cooling fuel												0.0000 (221)
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Electricity for pumps and fans:												
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Total electricity for the above, kWh/year												86.0000 (231)
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Electricity for lighting (calculated in Appendix L)												218.8822 (232)
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Energy saving/generation technologies (Appendices M ,N and Q)												
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PV generation												-4501.8572 (233)
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Wind generation												0.0000 (234)
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Hydro-electric generation (Appendix N)												0.0000 (235a)
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Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
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Appendix Q - special features												
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Energy saved or generated												-0.0000 (236)
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Energy used												0.0000 (237)
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Total delivered energy for all uses												3243.5802 (238)
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----- 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4520.9473	0.2100	949.3989 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2919.6079	0.2100	613.1177 (264)
Space and water heating			1562.5166 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	218.8822	0.1443	31.5915 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1211.7772	0.1363	-165.1200
PV Unit electricity exported	-3290.0800	0.1267	-416.7188
Total			-581.8388 (269)
Total CO2, kg/year			1024.1985 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2500 (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	4520.9473	1.1300	5108.6704 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2919.6079	1.1300	3299.1569 (278)
Space and water heating			8407.8274 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	218.8822	1.5338	335.7288 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1211.7772	1.5037	-1822.1428
PV Unit electricity exported	-3290.0800	0.4650	-1529.7548
Total			-3351.8976 (283)
Total Primary energy kWh/year			5521.7594 (286)
Target Primary Energy Rate (TPER)			60.6300 (287)