

Project No: 24387

Bury Metropolitan Borough Council
Energy Statement

Proposed Development at Underhill, Redisher Lane, Ramsbottom, Bury, BL8 4HX

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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 Bury Metropolitan Borough Council and moreover the Places for Everyone (PfE) Joint Development Plan Document (DPD), in respect to the proposed construction of a detached 3no. storey dwelling at Underhill, Redisher Lane, Ramsbottom, Bury, BL8 4HX.

The Statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of enhanced insulation standards and improved HVAC & lighting efficiencies, together with the installation of low carbon and renewable technologies. The methodology used herein is consistent with the widely regarded energy hierarchy approach to improving the energy performance of buildings and Approved Document L 2021 of the Building Regulations.

The report clearly demonstrates that the proposed development will be net zero carbon with predicted overall carbon dioxide emissions of **-72.54 kg/year**, whilst the residential aspect will also have a space heating demand of **19.79 kWh/m²/year**, together with a **68.12%** reduction in the energy required for water heating.

This will be achieved through enhanced insulation standards, the installation of an MCS-approved Air Source Heat Pump (ASHP), together with a PV array with a minimum output capacity of 6.80 kWp. It is initially thought that the PV installation will comprise of 8 x 400 W panels being installed on the West-facing pitched roof to the front and a further 9 x 400 W panels on the East-facing pitched roof space to the side, equating to approximately 34.00 m² of roof space in total.

In the circumstances, the proposed energy strategy and predicted energy performance of the proposed development is therefore deemed to satisfy the mandatory planning requirements of *Policy JP-S2: Carbon and Energy* of the PfE Joint DPD (March 2024).

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1.0 Introduction

- 1.1 EPS Group have been appointed to provide an Energy Statement to support the planning application in relation to the proposed construction of a 3no. storey dwelling at Underhill, Redisher Lane, Ramsbottom, Bury, BL8 4HX.
- 1.2 It is anticipated that the dwelling will need to comply with the requirements of Approved Document L1 2021 of the Building Regulations.
- 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 regulated carbon dioxide (CO₂) emissions of the development and the associated reduction targets.
- 1.4 The following fuel emissions factors have been used within the underlying calculations as defined by the updated NCM:

Fuel	CO ₂ emission factor (kgCO ₂ /kWh)
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 calculation utilised within the report relies on a number of standard operational parameters which may not ultimately match the actual measures adopted within the finalised development. 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 for all units 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:

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

161. *The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks 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

162. *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 and drought from rising temperatures⁶¹. Policies should support appropriate measures to ensure the future health and 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.*

163. *The need to mitigate and adapt to climate change should also be considered in preparing and assessing planning applications, taking into account the full range of potential climate change impacts.*

164. *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 incorporating green infrastructure and sustainable drainage systems; and

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

165. *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, and their future re-powering and life extension, while ensuring that adverse impacts are addressed appropriately (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.
166. 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.
167. Local planning authorities should also 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.
168. When determining planning applications for all forms of renewable and low carbon energy developments and their associated infrastructure, local planning authorities should:
- a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and give significant weight to the benefits associated with renewable and low carbon energy generation and the proposal's contribution to a net zero future;
 - b) recognise that small-scale and community-led projects provide a valuable contribution to cutting greenhouse gas emissions;
 - 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.
169. 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."

2.2 Local

The Places for Everyone Joint Development Plan 2022 to 2039 was adopted with effect from 21 March 2024 and includes the following relevant policy

"Policy JP-S2: Carbon and Energy

The aim of delivering a carbon neutral Greater Manchester no later than 2038, with a dramatic reduction in greenhouse gas emissions, will be supported through a range of measures including:

1. *Promoting the retrofitting of existing buildings with measures to improve energy efficiency and generate renewable and low carbon energy, heating and cooling;*
2. *Promoting the use of life cycle cost and carbon assessment tools to ensure the long-term impacts from development can be captured;*
3. *Taking a positive approach to renewable and low carbon energy schemes, particularly schemes that are led by, or meet the needs of local communities;*

4. *Increasing the range of nature-based solutions including carbon sequestration through the restoration of peat-based habitats, woodland management, tree planting and natural flood management techniques;*
5. *An expectation that new development will, unless it can be demonstrated that it is not practicable or financially viable;*

a. *Be net zero carbon which applies:*

- *from adoption – to regulated operational carbon emissions;*
- *from 2028 – to all emissions ‘in construction’.*

From 2025 development should also calculate and minimise carbon emissions from unregulated emissions alongside regulated emissions.

Development proposals should set out how this has been achieved in an energy statement in accordance with the energy hierarchy, which in order of importance seeks to:

- i. *Minimise energy demand;*
- ii. *Maximise energy efficiency;*
- iii. *Use renewable energy;*
- iv. *Use low carbon energy; and*
- v. *Utilise other energy sources.*

From 2025 any residual carbon emissions that cannot be fully mitigated on-site should be offset, in agreement with the relevant local planning authority through a financial contribution to a carbon offset fund.

As an interim measure, development should be consistent with the 2022 Part L Building Regulations unless superseded by changes to building regulations and/or national or local planning policies.

b. *Incorporate adequate electric vehicle charging points, in line with Part S of the Building Regulations, unless superseded by relevant Local Plan policies, to future proof for the likely long-term demand, taking account of the potential maximum energy demand for the site;*

c. *Where practicable, prioritise connection to a renewable energy/heating/cooling network in the first instance or a low carbon energy/heating/cooling network that is adaptable to non-fossil fuels at a later date;*

d. *In residential developments, achieve energy demand reductions in terms of space heat demand; hot water energy demand and the delivery of on-site renewable energy generation, in accordance with Table 5.1.*

For renewable energy generation priority should be given to PV installation where technically feasible, alternative technologies will be appropriate where the equivalent generation is evidenced.

e. *For non-residential developments, achieve at least BREEAM excellent standard (or equivalent) for the ‘Ene 01 – reduction of energy use and carbon emissions’ category rising to ‘BREEAM outstanding’ equivalent for ENE 01 from 2028.*

f. *Include a detailed energy statement to demonstrate via site relevant evidence how the development has sought to maximize reductions in carbon emissions in line with relevant policy targets, including the minimisation of*

overheating risks and appropriate measures for post occupancy evaluation. Whole life cycle emissions should be considered where possible.

Districts may set out specific carbon emission reduction and energy demand targets within Local Plans."

Table 5.1 Best Practice Thresholds for Reducing Energy Demand and Onsite Renewable Energy Generation within residential developments

-	Space Heat Demand ²⁵	Hot Water Energy Demand ²⁶	Renewable Energy Generation Targets
2021 - 2025	Houses (30kWh/m ²) Flats (25kWh/m ²)	20% energy demand reduction in the total heat required for water heating	*Photovoltaic installation: 20% ground floorspace
2025 - onwards	Houses (20kWh/m ²) Flats (15kWh/m ²)	^20% energy demand reduction in the total heat required for water heating	*Photovoltaic installation: 40% ground floorspace
*Ground floorspace used as a proxy for available roof area.	-	-	-
^will need to be reviewed with Future Homes Standard 2025 to determine if savings already embedded.	-	-	-

2.3 Conclusions

On review of the above planning requirements, it is evident that there is a need to construct dwellings with an energy performance standard significantly beyond the mandatory requirements of Approved Document L 2021 of the Building Regulations.

In particular, the development will need to target net zero carbon and the residential aspect will need to achieve a maximum space heating demand of 20 kWh/m²/yr, together with a 20% reduction in the energy required for water heating.

Furthermore, the development will need to incorporate a Photovoltaic installation equivalent to 40% of the ground floor space.

3.0 Proposed Energy Strategy

- 3.1 The proposed development 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 installation of mechanical cooling in the dwelling.
- 3.2 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 development as a means of reducing the overall regulated energy demand prior to considering the use of renewable technologies:

Table 1: Proposed 'Lean' Fabric and Lighting Standards		
Element / Feature	Current Approved Document L 2021 Minimal Acceptable Standard	Proposed Development Target
External Wall U-value	0.26 W/m ² K	0.16 W/m²K
Stud Wall to Void U-value	0.18 W/m ² K	0.13 W/m²K
Ground Floor U-Value	0.18 W/m ² K	0.12 W/m²K
Sloped Ceiling U-Value	0.16 W/m ² k	0.14 W/m²K
Plane Ceiling U-Value	0.16 W/m ² k	0.10 W/m²K
Glazing U-Value	1.60 W/m ² K	1.20 W/m²K
Air Permeability	8.00 m ³ /m ² .h	2.50 m³/m².h
Thermal Bridging	-	Recognised Construction Details
Lighting	All fixed lighting to have an efficacy of 75 lm/W	120 lm/W
Proposed HVAC Standards		
Space Heating	MCS Approved Air Source Heat Pump to Zoned Underfloor Heating (Mitsubishi Ecodan 8.5 kW PUZ-WM85VAA)	
Hot Water	150 litre storage cylinder with a declared heat loss of 2.09 kWh/day Shower to have max. 11.00 l/s flow rate	
Heating Controls	Time and Temperature Zone Control	
Ventilation	Mechanical Ventilation with Heat Recovery Unit (Nuaire MRXBOX-ECO3)	

- 3.3 The above build standards will ensure that the development has a vastly reduced energy demand in comparison to the minimum requirements of Approved Document L 2021 of the Building Regulations. This will help to reduce the overall energy consumption and the associated CO₂ emissions arising from occupancy.

4.0 Review of Low Carbon and Renewable Technologies

4.1 In response to the local planning requirements and in line with the 'Green' principles of the Energy Hierarchy 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 urban location which would result in unreliable and insufficient outputs. - Requires ongoing 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 ongoing costs & maintenance issues following installation. - The development benefits from large areas of pitched roof space, allowing higher efficiency generation of any installed PV panels. - Easy to integrate into a conventional build specification.
Site Limitations / Restrictions	- PV panels are not always aesthetically pleasing and may detract from the visual appearance of the development. - South-facing pitched roof space is unavailable for ideal installation - 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	It is proposed to use this technology 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 ongoing costs & maintenance issues following installation.
Site Limitations / Restrictions	- The amount of CO₂/useful energy savings with this technology is restricted as there is no benefit to producing more hot water than is used within a building. - Solar collectors are not always aesthetically pleasing and may detract from the visual appearance of the development.
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). • Reliable and proven technology. • Generally low maintenance costs. • No visual impact on the development.
Site Limitations / Restrictions	• Detailed ground surveys required. • Trench installations require significant areas of land. • Minimal space to facilitate an installation. • High capital installation costs potentially rendering the technology financially unviable. • If sufficient capacity isn't available within the Distribution Network, then local upgrades may be required which could render the technology financially unviable.
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 requires a supplementary immersion heating system for the production of hot water. • 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 proposed to use this technology within the proposed development (as detailed in Table 1).

4.7 Biomass Boilers

Benefits	• Reliable and proven technology.
Site Limitations / Restrictions	• Require large storage facilities for the fuel. • Ongoing cleaning, maintenance and management requirements. • Require regular fuel deliveries. • Would contribute to poor local air quality.
Conclusion	• It is not proposed to use this technology within the proposed development.

4.8 On review of the above technologies, the use of PV panels is recommended as being the most viable 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 an affordable reduction in the calculated carbon dioxide emissions.

4.9 It is therefore proposed to install a PV array with a total minimum output capacity of 6.80 kWp. It is initially thought that the PV installation will comprise of 8 x 400 W panels being installed on the West-facing pitched roof to the front and a further 9 x 400 W panels on the East-facing pitched roof space to the side, equating to approximately 34.00 m² of roof space in total.

4.10 Furthermore, as detailed in Section 3, the use of Air Source Heat Pump technology is proposed as a means of providing the dwelling with a decentralised source of low carbon heating and hot water.

4.11 The solar PV array, air source heat pump and hot water systems will be designed, tested and commissioned to current approved standards.

5.0 Calculated Energy Performance - Illustrative

- 5.1 SAP 10 has been utilised as an appropriate method for calculating the predicted energy consumption arising from the proposed dwelling. The benefit of this method is that it enables improvements in both build fabric and system efficiencies to be fully quantified. As such, it is consistent with the Energy Hierarchy approach to energy conservation.
- 5.2 Predictive SAP 10 Calculations were prepared for the development based upon the proposed design parameters outlined within Section 3 of this report, together with the PV proposals outlined in Paragraph 4.9.
- 5.3 The key results of these calculations are summarised within the tables below with the full SAP calculation worksheets provided within the Appendices of this report for detailed review:

Table 2: Development CO ₂ Emissions (SAP 10)		
Floor Area (m ²)	Dwelling Emission Rate (DER)	Annual Proposed CO ₂ Emissions (Kg/Year)
215.09	-0.34	-72.54

Table 3: Development Energy Demand (SAP 10)			
Floor Area (m ²)	Space Heating Demand (kWh/m ² /yr)	Target Hot Water Demand (kWh/yr)	Proposed Hot Water Demand (kWh/yr)
215.09	19.79	3,161.85	1,007.9427
Percentage Reduction in the Hot Water Energy Demand			68.12%

- 5.4 Upon review of the above, it is evident that the proposed development will be net zero carbon with predicted overall carbon dioxide emissions of **-72.54 kg/year**, also featuring a space heating demand of **19.79 kWh/m²/year**, together with a **68.12%** reduction in the energy required for water heating.
- 5.5 In the circumstances, the proposed energy strategy and predicted energy performance of the proposed development is therefore deemed to satisfy the mandatory planning requirements of *Policy JP-S2: Carbon and Energy* of the PfE Joint DPD (March 2024).



Appendix 1:

Baseline TER and Renewable DER Calculations (SAP Derived)

Full SAP Calculation Printout



Plot Reference	24387				Issued on Date	01/04/2026	
Assessment Reference	001			Plot Type Ref	EST		
Plot Address	Underhill, Redisher Lane, Ramsbottom, BL8 4HX				SAP Version	10.2	
SAP Rating	98 A	DER	-0.34	TER	8.49		
Environmental	100 A	% DER < TER				104.00	
CO ₂ Emissions (t/year)	0	DFEE	33.10	TFEE	38.10		
Compliance Check	See BREL	% DFEE < TFEE				13.12	
% DPER < TPER	85.21	DPER	6.57	TPER	44.44		
Assessor Details	Mr. Samuel Marks				Assessor ID	BP82-0001	
Client	24387, Chris Wilkinson						

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)
Main dwelling			
Ground floor	80.6300 (1b)	x 2.3600 (2b)	= 190.2868 (1b) - (3b)
First floor	80.6300 (1c)	x 2.5500 (2c)	= 205.6065 (1c) - (3c)
Second floor	53.8400 (1d)	x 2.3900 (2d)	= 128.6776 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	215.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	524.5709 (5)

2. Ventilation rate

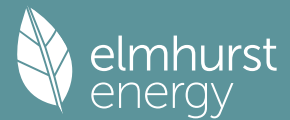
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	2.5000 (17)
Infiltration rate	0.1250 (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) = 0.1062 (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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												70.4000 (23c)
Effective ac	0.2835	0.2808	0.2782	0.2649	0.2622	0.2489	0.2489	0.2463	0.2542	0.2622	0.2675	0.2728 (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
Main dwelling							
Window			31.1200	1.1450	35.6336		(27)
Roof Light			2.4700	1.1450	2.8282		(27a)
Floor			80.6300	0.1200	9.6756	110.0000	8869.3000 (28a)
Wall	231.8300	31.1200	200.7100	0.1600	32.1136	60.0000	12042.6000 (29a)
Studs to Void	41.7000		41.7000	0.1200	5.0040	9.0000	375.3000 (29a)
Plane	35.0700		35.0700	0.1000	3.5070	9.0000	315.6300 (30)
shPlane	26.7800		26.7800	0.0952	2.5505	9.0000	241.0200 (30)
Sloped	24.9300	2.4700	22.4600	0.1400	3.1444	9.0000	202.1400 (30)
Total net area of external elements Aum(A, m ²)			440.9400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		94.4569		(33)
Main dwelling							
TG			83.1200			9.0000	748.0800 (32c)
T1			156.4700			9.0000	1408.2300 (32c)

Full SAP Calculation Printout



T2	73.9200	9.0000	665.2800 (32c)
Internal Floor	134.4700	18.0000	2420.4600 (32d)
Internal Ceiling	134.4700	9.0000	1210.2300 (32e)

Heat capacity Cm = Sum(A x k)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
 List of Thermal Bridges

Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	22.1000	0.0260	0.5746
E3 Sill	22.1000	0.0230	0.5083
E4 Jamb	46.9000	0.0180	0.8442
E5 Ground floor (normal)	40.8200	0.0510	2.0818
E6 Intermediate floor within a dwelling	40.8200	0.0010	0.0408
E16 Corner (normal)	44.2600	0.0400	1.7704
R11 Upstands or kerbs of rooflights	6.4000	0.2400	1.5360
E17 Corner (inverted - internal area greater than external area)	20.5100	0.0820	1.6818
E10 Eaves (insulation at ceiling level)	25.3200	0.0550	1.3926
E11 Eaves (insulation at rafter level)	22.3200	0.0180	0.4018
E12 Gable (insulation at ceiling level)	11.5100	0.0370	0.4259
E13 Gable (insulation at rafter level)	5.4100	0.0390	0.2110
R6 Flat ceiling	22.5600	0.0380	0.8573

Thermal bridges (Sum(L x Psi) calculated using Appendix K)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 106.7834 (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	49.0708	48.6110	48.1512	45.8521	45.3923	43.0932	43.0932	42.6334	44.0128	45.3923	46.3119	47.2315	(38)
Heat transfer coeff	155.8542	155.3944	154.9346	152.6355	152.1756	149.8765	149.8765	149.4167	150.7962	152.1756	153.0953	154.0149	(39)
Average = Sum(39)m / 12 =												152.5205	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.7246	0.7224	0.7203	0.7096	0.7075	0.6968	0.6968	0.6946	0.7011	0.7075	0.7117	0.7160	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

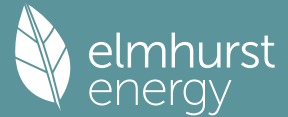
Assumed occupancy													3.0216 (42)
Hot water usage for mixer showers	84.2417	82.9757	81.1309	77.6012	74.9964	72.0915	70.4404	72.2712	74.2782	77.3971	81.0026	83.9189	(42a)
Hot water usage for baths	32.3247	31.8446	31.1686	29.9221	28.9888	27.9538	27.3948	28.0661	28.7970	29.9045	31.1766	32.2154	(42b)
Hot water usage for other uses	45.5738	43.9166	42.2593	40.6021	38.9449	37.2876	37.2876	38.9449	40.6021	42.2593	43.9166	45.5738	(42c)
Average daily hot water use (litres/day)												149.0688	(43)
Daily hot water use	162.1401	158.7369	154.5588	148.1254	142.9300	137.3330	135.1228	139.2822	143.6773	149.5609	156.0958	161.7081	(44)
Energy content (annual)	256.7904	226.0392	237.5511	202.7763	192.4113	168.8669	163.4193	172.4604	177.1685	202.9527	222.3870	253.1958	(45)
Distribution loss (46)m = 0.15 x (45)m	38.5186	33.9059	35.6327	30.4164	28.8617	25.3300	24.5129	25.8691	26.5753	30.4429	33.3581	37.9794	(46)
Water storage loss (or HIU loss):													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1286	(55)
Total storage loss	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)
If cylinder contains dedicated solar storage	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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	315.0394	278.6512	295.8001	259.1463	250.6603	225.2369	221.6683	230.7094	233.5385	261.2017	278.7570	311.4448	(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	315.0394	278.6512	295.8001	259.1463	250.6603	225.2369	221.6683	230.7094	233.5385	261.2017	278.7570	311.4448	(64)
12Total per year (kWh/year)												3161.8539	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	131.9820	117.2476	125.5849	112.5191	110.5759	101.2442	100.9361	103.9423	104.0045	114.0810	119.0397	130.7868	(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	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	203.0632	224.8199	203.0632	209.8320	203.0632	209.8320	203.0632	203.0632	209.8320	203.0632	209.8320	203.0632	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	385.1794	389.1764	379.1042	357.6616	330.5943	305.1548	288.1597	284.1627	294.2349	315.6775	342.7448	368.1843	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	(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)	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	(71)
Water heating gains (Table 5)	177.3952	174.4756	168.7970	156.2765	148.6236	140.6170	135.6668	139.7074	144.4507	153.3346	165.3329	175.7887	(72)
Total internal gains	833.9611	856.7953	819.2877	792.0935	750.6044	723.9272	695.2131	695.2567	716.8410	740.3987	786.2330	815.3596	(73)

6. Solar gains

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[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	15.6900	10.6334	0.6300	0.7000	0.7700	50.9878 (74)
East	0.9900	19.6403	0.6300	0.7000	0.7700	5.9423 (76)
South	12.4600	46.7521	0.6300	0.7000	0.7700	178.0290 (78)
West	1.9800	19.6403	0.6300	0.7000	0.7700	11.8846 (80)
East	2.4700	26.1244	0.6300	0.7000	1.0000	25.6109 (82)

Solar gains	272.4546	475.2190	682.1172	902.4767	1065.9213	1083.1774	1033.8551	907.6121	757.4934	533.5934	328.3075	231.9205 (83)
Total gains	1106.4157	1332.0143	1501.4049	1694.5703	1816.5258	1807.1046	1729.0682	1602.8688	1474.3343	1273.9921	1114.5405	1047.2801 (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	50.7923	50.9426	51.0937	51.8634	52.0201	52.8180	52.8180	52.9806	52.4959	52.0201	51.7076	51.3988
alpha	4.3862	4.3962	4.4062	4.4576	4.4680	4.5212	4.5212	4.5320	4.4997	4.4680	4.4472	4.4266
util living area	0.9864	0.9697	0.9367	0.8501	0.7033	0.5161	0.3784	0.4235	0.6550	0.8935	0.9723	0.9891 (86)
Living	19.9041	20.1081	20.3590	20.6536	20.8369	20.9134	20.9280	20.9259	20.8801	20.6276	20.2189	19.8745
Non living	19.0031	19.2629	19.5789	19.9450	20.1552	20.2418	20.2538	20.2545	20.2084	19.9222	19.4128	18.9713
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.4394	20.1081	20.3590	20.6536	20.8369	20.9134	20.9280	20.9259	20.8801	20.6276	20.2189	20.0319 (87)
Th 2	20.3192	20.3211	20.3229	20.3324	20.3342	20.3437	20.3437	20.3456	20.3399	20.3342	20.3305	20.3267 (88)
util rest of house	0.9841	0.9649	0.9268	0.8285	0.6666	0.4675	0.3231	0.3653	0.6048	0.8729	0.9672	0.9872 (89)
MIT 2	19.7945	19.2629	19.5789	19.9450	20.1552	20.2418	20.2538	20.2545	20.2084	19.9222	19.4128	19.2155 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.8720	19.3644	19.6726	20.0301	20.2371	20.3225	20.3348	20.3351	20.2891	20.0069	19.5096	19.3136 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8720	19.3644	19.6726	20.0301	20.2371	20.3225	20.3348	20.3351	20.2891	20.0069	19.5096	19.3136 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9824	0.9566	0.9156	0.8178	0.6610	0.4659	0.3224	0.3643	0.6007	0.8613	0.9592	0.9838 (94)
Useful gains	1086.9325	1274.1804	1374.6871	1385.8146	1200.6380	841.9046	557.4472	584.0024	885.6824	1097.3235	1069.0636	1030.2671 (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	2426.9591	2247.6882	2040.8863	1698.8528	1299.1377	857.6661	559.7617	587.9714	933.2975	1431.5026	1899.8575	2327.7220 (97)
Space heating kWh	996.9798	654.1973	495.6522	225.3875	73.2837	0.0000	0.0000	0.0000	0.0000	248.6293	598.1716	965.3065 (98a)
Space heating requirement - total per year (kWh/year)												4257.6078
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	996.9798	654.1973	495.6522	225.3875	73.2837	0.0000	0.0000	0.0000	0.0000	248.6293	598.1716	965.3065 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4257.6078
Space heating per m2										(98c) / (4) =		19.7936 (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 %)												309.6729 (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	996.9798	654.1973	495.6522	225.3875	73.2837	0.0000	0.0000	0.0000	0.0000	248.6293	598.1716	965.3065 (98)
Space heating efficiency (main heating system 1)	309.6729	309.6729	309.6729	309.6729	309.6729	0.0000	0.0000	0.0000	0.0000	309.6729	309.6729	309.6729 (210)
Space heating fuel (main heating system)	321.9461	211.2543	160.0567	72.7824	23.6649	0.0000	0.0000	0.0000	0.0000	80.2877	193.1624	311.7181 (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	315.0394	278.6512	295.8001	259.1463	250.6603	225.2369	221.6683	230.7094	233.5385	261.2017	278.7570	311.4448 (64)
Efficiency of water heater												281.4244 (216)
(217)m	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244	281.4244 (217)
Fuel for water heating, kWh/month	111.9446	99.0146	105.1082	92.0838	89.0684	80.0346	78.7666	81.9792	82.9844	92.8142	99.0522	110.6673 (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	51.6365	46.6394	51.6365	49.9708	51.6365	49.9708	51.6365	51.6365	49.9708	51.6365	49.9708	51.6365 (231)
Lighting	49.3422	39.5842	35.6412	26.1122	20.1699	16.4789	18.3996	23.9165	31.0652	40.7592	46.0374	50.7136 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-75.6183	-116.0600	-180.4688	-207.7267	-221.1326	-202.7440	-199.8450	-187.0967	-161.5557	-132.8896	-84.7091	-63.5305 (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)												

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(233b)m	-29.3246	-73.5832	-177.2437	-315.7590	-459.2212	-478.7928	-467.4276	-374.3582	-247.0707	-119.3569	-42.7252	-22.2428	(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												1374.8725	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												281.4244	
Water heating fuel used												1123.5181	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500)													
mechanical ventilation fans (SFP = 0.9500)												607.9777	(230a)
Total electricity for the above, kWh/year												607.9777	(231)
Electricity for lighting (calculated in Appendix L)												398.2202	(232)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4640.4828	(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												-1135.8943	(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	1374.8725	0.1565	215.1949	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1123.5181	0.1410	158.3673	(264)
Space and water heating			373.5622	(265)
Pumps, fans and electric keep-hot	607.9777	0.1387	84.3340	(267)
Energy for lighting	398.2202	0.1443	57.4755	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1833.3769	0.1341	-245.7978	
PV Unit electricity exported	-2807.1058	0.1219	-342.1188	
Total			-587.9166	(269)
Total CO2, kg/year			-72.5449	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.3400	(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	1374.8725	1.5794	2171.4969	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1123.5181	1.5212	1709.1061	(278)
Space and water heating			3880.6029	(279)
Pumps, fans and electric keep-hot	607.9777	1.5128	919.7486	(281)
Energy for lighting	398.2202	1.5338	610.8034	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1833.3769	1.4955	-2741.7882	
PV Unit electricity exported	-2807.1058	0.4472	-1255.2875	
Total			-3997.0757	(283)
Total Primary energy kWh/year			1414.0793	(286)
Dwelling Primary energy Rate (DPER)			6.5700	(287)

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

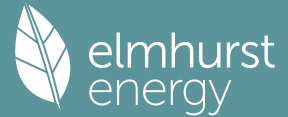
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	80.6300 (1b)	x 2.3600 (2b)	= 190.2868 (1b) - (3b)	
First floor	80.6300 (1c)	x 2.5500 (2c)	= 205.6065 (1c) - (3c)	
Second floor	53.8400 (1d)	x 2.3900 (2d)	= 128.6776 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n)	215.1000			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)... (3n) =	524.5709	(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)

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Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0763 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3263	(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) =	0.2773 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000	(22)
Wind factor	Jan 1.2750 Feb 1.2500 Mar 1.2250 Apr 1.1000 May 1.0750 Jun 0.9500 Jul 0.9500 Aug 0.9250 Sep 1.0000 Oct 1.0750 Nov 1.1250 Dec 1.1750	(22a)
Adj infilt rate	0.3536 0.3466 0.3397 0.3050 0.2981 0.2634 0.2634 0.2565 0.2773 0.2981 0.3120 0.3258	(22b)
Effective ac	0.5625 0.5601 0.5577 0.5465 0.5444 0.5347 0.5347 0.5329 0.5385 0.5444 0.5487 0.5531	(25)

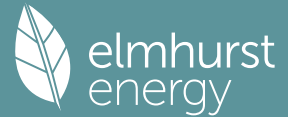
3. Heat losses and heat loss parameter

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
Main dwelling							
TER Opening Type			31.1200	1.1450	35.6336		(27)
TER Roof Light			2.4700	1.5918	4.5741		(27a)
Floor			80.6300	0.1300	10.4819		(28a)
Wall	231.8300	31.1200	200.7100	0.1800	36.1278		(29a)
Studs to Void	41.7000		41.7000	0.1800	7.5060		(29a)
Plane	35.0700		35.0700	0.1100	3.8577		(30)
shPlane	26.7800		26.7800	0.1100	2.9458		(30)
Sloped	24.9300	2.4700	22.4600	0.1100	2.4706		(30)
Total net area of external elements Aum(A, m2)			440.9400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.5975		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							132.4885 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				22.1000	0.0500	1.1050	
E3 Sill				22.1000	0.0500	1.1050	
E4 Jamb				46.9000	0.0500	2.3450	
E5 Ground floor (normal)				40.8200	0.1600	6.5312	
E6 Intermediate floor within a dwelling				40.8200	0.0000	0.0000	
E16 Corner (normal)				44.2600	0.0900	3.9834	
R11 Upstands or kerbs of rooflights				6.4000	0.0800	0.5120	
E17 Corner (inverted - internal area greater than external area)				20.5100	-0.0900	-1.8459	
E10 Eaves (insulation at ceiling level)				25.3200	0.0600	1.5192	
E11 Eaves (insulation at rafter level)				22.3200	0.0400	0.8928	
E12 Gable (insulation at ceiling level)				11.5100	0.0600	0.6906	
E13 Gable (insulation at rafter level)				5.4100	0.0800	0.4328	
R6 Flat ceiling				22.5600	0.0600	1.3536	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						18.6247	(36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	122.2222 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	Jan 97.3749 Feb 96.9547 Mar 96.5428 Apr 94.6084 May 94.2464 Jun 92.5615 Jul 92.5615 Aug 92.2495 Sep 93.2105 Oct 94.2464 Nov 94.9786 Dec 95.7441						(38)
Heat transfer coeff	219.5970 219.1769 218.7650 216.8305 216.4686 214.7837 214.7837 214.4717 215.4327 216.4686 217.2008 217.9662						(39)
Average = Sum(39)m / 12 =							216.8288
HLP	Jan 1.0209 Feb 1.0190 Mar 1.0170 Apr 1.0080 May 1.0064 Jun 0.9985 Jul 0.9985 Aug 0.9971 Sep 1.0015 Oct 1.0064 Nov 1.0098 Dec 1.0133						(40)
HLP (average)							1.0080
Days in mont	31 28 31 30 31 30 31 31 30 31 30 31						

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0216 (42)
Hot water usage for mixer showers	74.8815	73.7562	72.1163	68.9788	66.6635	64.0814	62.6137	64.2411	66.0250	68.7974	72.0023	74.5946	(42a)
Hot water usage for baths	32.3247	31.8446	31.1686	29.9221	28.9888	27.9538	27.3948	28.0661	28.7970	29.9045	31.1766	32.2154	(42b)
Hot water usage for other uses	45.5738	43.9166	42.2593	40.6021	38.9449	37.2876	37.2876	38.9449	40.6021	42.2593	43.9166	45.5738	(42c)
Average daily hot water use (litres/day)													140.4390 (43)
Daily hot water use	Jan 152.7800 Feb 149.5173 Mar 145.5443 Apr 139.5031 May 134.5971 Jun 129.3228 Jul 127.2961 Aug 131.2521 Sep 135.4242 Oct 140.9612 Nov 147.0955 Dec 152.3838												(44)
Energy conte	241.9661	212.9107	223.6961	190.9727	181.1935	159.0175	153.9536	162.5175	166.9915	191.2830	209.5645	238.5962	(45)
Energy content (annual)										Total = Sum(45)m =		2332.6629	
Distribution loss (46)m = 0.15 x (45)m	36.2949	31.9366	33.5544	28.6459	27.1790	23.8526	23.0930	24.3776	25.0487	28.6925	31.4347	35.7894	(46)
Water storage loss (or HIU loss):													
Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7527 (55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	288.5610	254.9964	270.2910	236.0645	227.7884	204.1093	200.5485	209.1124	212.0834	237.8779	254.6563	285.1911	(62)
WWHRS	-34.2327	-30.2757	-31.7029	-26.2513	-24.4653	-20.9351	-19.6233	-20.8674	-21.6602	-25.5350	-28.9281	-33.5987	(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)

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FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	254.3283	224.7208	238.5881	209.8133	203.3232	183.1742	180.9252	188.2449	190.4231	212.3429	225.7282	251.5923 (64)
	Total per year (kWh/year) = Sum(64)m =											2563.2045 (64)
12Total per year (kWh/year)												2563 (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	117.7297	104.4614	111.6549	99.5719	97.5228	88.9468	88.4655	91.3130	91.5982	100.8775	105.7537	116.6092 (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	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	203.0632	224.8199	203.0632	209.8320	203.0632	209.8320	203.0632	203.0632	209.8320	203.0632	209.8320	203.0632	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	385.1794	389.1764	379.1042	357.6616	330.5943	305.1548	288.1597	284.1627	294.2349	315.6775	342.7448	368.1843	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	(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)	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	(71)
Water heating gains (Table 5)	158.2388	155.4485	150.0738	138.2943	131.0790	123.5372	118.9052	122.7325	127.2197	135.5881	146.8801	156.7327	(72)
Total internal gains	817.8048	840.7682	803.5645	777.1113	736.0599	706.8474	678.4515	678.2818	699.6099	725.6521	770.7802	799.3036	(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						15.6900	10.6334	0.6300	0.7000	0.7700		50.9878 (74)
East						0.9900	19.6403	0.6300	0.7000	0.7700		5.9423 (76)
South						12.4600	46.7521	0.6300	0.7000	0.7700		178.0290 (78)
West						1.9800	19.6403	0.6300	0.7000	0.7700		11.8846 (80)
East						2.4700	26.1244	0.6300	0.7000	1.0000		25.6109 (82)
Solar gains	272.4546	475.2190	682.1172	902.4767	1065.9213	1083.1774	1033.8551	907.6121	757.4934	533.5934	328.3075	231.9205 (83)
Total gains	1090.2593	1315.9872	1485.6817	1679.5880	1801.9812	1790.0248	1712.3066	1585.8939	1457.1033	1259.2455	1099.0877	1031.2241 (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	36.0487	36.1178	36.1858	36.5086	36.5697	36.8566	36.8566	36.9102	36.7455	36.5697	36.4464	36.3184
alpha	3.4032	3.4079	3.4124	3.4339	3.4380	3.4571	3.4571	3.4607	3.4497	3.4380	3.4298	3.4212
util living area	0.9886	0.9780	0.9586	0.9097	0.8155	0.6645	0.5178	0.5704	0.7829	0.9353	0.9799	0.9906 (86)
MIT	18.8666	19.1520	19.5582	20.0938	20.5502	20.8465	20.9516	20.9320	20.7135	20.1117	19.3946	18.8197 (87)
Th 2	20.0659	20.0676	20.0692	20.0766	20.0780	20.0846	20.0846	20.0858	20.0820	20.0780	20.0752	20.0722 (88)
util rest of house	0.9865	0.9739	0.9506	0.8915	0.7772	0.5954	0.4227	0.4749	0.7255	0.9186	0.9755	0.9888 (89)
MIT 2	17.5428	17.9067	18.4221	19.0938	19.6393	19.9652	20.0583	20.0461	19.8358	19.1277	18.2231	17.4869 (90)
Living area fraction	fLA = Living area / (4) =											0.1201 (91)
MIT	17.7019	18.0563	18.5586	19.2139	19.7487	20.0710	20.1656	20.1525	19.9412	19.2459	18.3638	17.6470 (92)
Temperature adjustment												0.0000
adjusted MIT	17.7019	18.0563	18.5586	19.2139	19.7487	20.0710	20.1656	20.1525	19.9412	19.2459	18.3638	17.6470 (93)

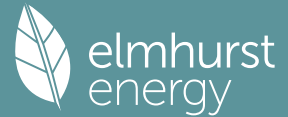
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9783	0.9613	0.9331	0.8705	0.7615	0.5943	0.4315	0.4824	0.7154	0.8988	0.9635	0.9816	(94)
Useful gains	1066.5795	1264.9985	1386.3069	1462.0019	1372.1222	1063.8252	738.8625	764.9662	1042.4321	1131.7936	1059.0170	1012.2889	(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	2943.0122	2883.5591	2637.9930	2236.3704	1742.2990	1175.0871	765.8255	804.7999	1258.3893	1871.5640	2446.5040	2930.9865	(97)
Space heating kWh	1396.0660	1087.6727	931.2545	557.5453	275.4115	0.0000	0.0000	0.0000	0.0000	550.3892	998.9907	1427.5110	(98a)
Space heating requirement - total per year (kWh/year)												7224.8409	
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	1396.0660	1087.6727	931.2545	557.5453	275.4115	0.0000	0.0000	0.0000	0.0000	550.3892	998.9907	1427.5110	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7224.8409	
Space heating per m2											(98c) / (4) =	33.5883	(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												

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Space heating efficiency (main heating system 1)	1396.0660	1087.6727	931.2545	557.5453	275.4115	0.0000	0.0000	0.0000	0.0000	550.3892	998.9907	1427.5110	(98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	1512.5309	1178.4103	1008.9431	604.0578	298.3873	0.0000	0.0000	0.0000	0.0000	596.3046	1082.3301	1546.5992	(211)
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	(212)
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	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	254.3283	224.7208	238.5881	209.8133	203.3232	183.1742	180.9252	188.2449	190.4231	212.3429	225.7282	251.5923	(64)
Efficiency of water heater (217)m	87.2830	87.1176	86.8034	86.1436	84.7409	79.8000	79.8000	79.8000	79.8000	86.0967	86.9917	79.8000	(216)
Fuel for water heating, kWh/month	291.3835	257.9510	274.8604	243.5623	239.9350	229.5416	226.7233	235.8959	238.6255	246.6330	259.4824	288.1126	(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	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	42.1925	33.8484	30.4767	22.3286	17.2472	14.0911	15.7335	20.4510	26.5638	34.8532	39.3666	43.3652	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-72.0929	-99.9619	-141.2679	-155.9506	-165.5908	-153.4316	-151.3163	-143.9776	-130.8385	-112.7243	-78.5718	-62.5079	(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	-45.9653	-96.0532	-189.8303	-283.6466	-373.7711	-375.2861	-371.0764	-314.9507	-231.7211	-137.1219	-61.2693	-36.4154	(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												7827.5633	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3032.7064	(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)												340.5178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3985.3398	(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												7301.4478	(238)

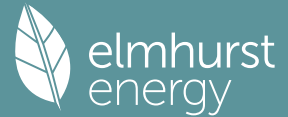
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	7827.5633	0.2100	1643.7883 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3032.7064	0.2100	636.8684 (264)
Space and water heating			2280.6566 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	340.5178	0.1443	49.1472 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1468.2324	0.1350	-198.1973
PV Unit electricity exported	-2517.1074	0.1260	-317.2443
Total			-515.4416 (269)
Total CO2, kg/year			1826.2916 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.4900 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	7827.5633	1.1300	8845.1465 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3032.7064	1.1300	3426.9583 (278)
Space and water heating			12272.1048 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	340.5178	1.5338	522.2976 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1468.2324	1.4989	-2200.7697
PV Unit electricity exported	-2517.1074	0.4626	-1164.5176
Total			-3365.2873 (283)
Total Primary energy kWh/year			9559.2159 (286)
Target Primary Energy Rate (TPER)			44.4400 (287)

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1. Overall dwelling characteristics

Main dwelling	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	80.6300 (1b)	x 2.3600 (2b)	= 190.2868 (1b) - (3b)
First floor	80.6300 (1c)	x 2.5500 (2c)	= 205.6065 (1c) - (3c)
Second floor	53.8400 (1d)	x 2.3900 (2d)	= 128.6776 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	215.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 524.5709 (5)

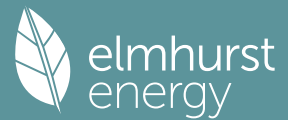
2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0763 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	2.5000 (17)
Infiltration rate	0.2013 (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) = 0.1711 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000 (22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750 (22a)
Adj infilt rate	0.2181 0.2138 0.2096 0.1882 0.1839 0.1625 0.1625 0.1582 0.1711 0.1839 0.1924 0.2010 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000 (23c)
Effective ac	0.5238 0.5229 0.5220 0.5177 0.5169 0.5132 0.5132 0.5125 0.5146 0.5169 0.5185 0.5202 (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
Main dwelling							
Window			31.1200	1.1450	35.6336		(27)
Roof Light			2.4700	1.1450	2.8282		(27a)
Floor			80.6300	0.1200	9.6756	110.0000	8869.3000 (28a)
Wall	231.8300	31.1200	200.7100	0.1600	32.1136	60.0000	12042.6000 (29a)
Studs to Void	41.7000		41.7000	0.1200	5.0040	9.0000	375.3000 (29a)
Plane	35.0700		35.0700	0.1000	3.5070	9.0000	315.6300 (30)
shPlane	26.7800		26.7800	0.0952	2.5505	9.0000	241.0200 (30)
Sloped	24.9300	2.4700	22.4600	0.1400	3.1444	9.0000	202.1400 (30)
Total net area of external elements Aum, m2)			440.9400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		94.4569		(33)
Main dwelling							
TG			83.1200			9.0000	748.0800 (32c)
T1			156.4700			9.0000	1408.2300 (32c)
T2			73.9200			9.0000	665.2800 (32c)
Internal Floor			134.4700			18.0000	2420.4600 (32d)
Internal Ceiling			134.4700			9.0000	1210.2300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	28498.2700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							132.4885 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				22.1000	0.0260	0.5746	
E3 Sill				22.1000	0.0230	0.5083	
E4 Jamb				46.9000	0.0180	0.8442	
E5 Ground floor (normal)				40.8200	0.0510	2.0818	
E6 Intermediate floor within a dwelling				40.8200	0.0010	0.0408	
E16 Corner (normal)				44.2600	0.0400	1.7704	
R11 Upstands or kerbs of rooflights				6.4000	0.2400	1.5360	
E17 Corner (inverted - internal area greater than external area)				20.5100	0.0820	1.6818	
E10 Eaves (insulation at ceiling level)				25.3200	0.0550	1.3926	
E11 Eaves (insulation at rafter level)				22.3200	0.0180	0.4018	
E12 Gable (insulation at ceiling level)				11.5100	0.0370	0.4259	
E13 Gable (insulation at rafter level)				5.4100	0.0390	0.2110	
R6 Flat ceiling				22.5600	0.0380	0.8573	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3265 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	106.7834 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	Jan 90.6717 Feb 90.5118 Mar 90.3551 Apr 89.6189 May 89.4812 Jun 88.8401 Jul 88.8401 Aug 88.7214 Sep 89.0871 Oct 89.4812 Nov 89.7598 Dec 90.0511 (38)						
Heat transfer coeff	197.4550 197.2951 197.1384 196.4023 196.2646 195.6235 195.6235 195.5047 195.8704 196.2646 196.5432 196.8345 (39)						
Average = Sum(39)m / 12 =							196.4017
HLP	Jan 0.9180 Feb 0.9172 Mar 0.9165 Apr 0.9131 May 0.9124 Jun 0.9095 Jul 0.9095 Aug 0.9089 Sep 0.9106 Oct 0.9124 Nov 0.9137 Dec 0.9151 (40)						
HLP (average)							0.9131
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												3.0216 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	32.3247	31.8446	31.1686	29.9221	28.9888	27.9538	27.3948	28.0661	28.7970	29.9045	31.1766	32.2154 (42b)
Hot water usage for other uses	45.5738	43.9166	42.2593	40.6021	38.9449	37.2876	37.2876	38.9449	40.6021	42.2593	43.9166	45.5738 (42c)
Average daily hot water use (litres/day)												71.4008 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	77.8985	75.7612	73.4279	70.5242	67.9336	65.2415	64.6824	67.0110	69.3991	72.1638	75.0932	77.7892 (44)
Energy content (annual)	123.3722	107.8829	112.8560	96.5441	91.4517	80.2220	78.2278	82.9736	85.5761	97.9256	106.9840	121.7991 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m =											1185.8150
Water storage loss (or HIU loss):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	104.8663	91.7005	95.9276	82.0625	77.7340	68.1887	66.4936	70.5275	72.7397	83.2367	90.9364	103.5292 (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	104.8663	91.7005	95.9276	82.0625	77.7340	68.1887	66.4936	70.5275	72.7397	83.2367	90.9364	103.5292 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											1007.9427 (64)
Electric shower(s)	59.9676	53.4316	58.3453	55.6782	56.7230	54.1082	55.9118	56.7230	55.6782	58.3453	57.2482	59.9676 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											682.1277 (64a)
Heat gains from water heating, kWh/month	41.2085	36.2830	38.5682	34.4352	33.6142	30.5742	30.6014	31.8126	32.1045	35.3955	37.0461	40.8742 (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	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	203.0632	224.8199	203.0632	209.8320	203.0632	209.8320	203.0632	203.0632	209.8320	203.0632	209.8320	203.0632
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	385.1794	389.1764	379.1042	357.6616	330.5943	305.1548	288.1597	284.1627	294.2349	315.6775	342.7448	368.1843
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078
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
Losses e.g. evaporation (negative values) (Table 5)	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623
Water heating gains (Table 5)	55.3877	53.9926	51.8390	47.8266	45.1804	42.4642	41.1309	42.7589	44.5895	47.5746	51.4530	54.9384
Total internal gains	711.9537	736.3123	702.3297	683.6436	647.1613	625.7743	600.6771	598.3082	616.9798	634.6386	672.3531	694.5093

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	15.6900	10.6334	0.6300	0.7000	0.7700	50.9878 (74)
East	0.9900	19.6403	0.6300	0.7000	0.7700	5.9423 (76)
South	12.4600	46.7521	0.6300	0.7000	0.7700	178.0290 (78)
West	1.9800	19.6403	0.6300	0.7000	0.7700	11.8846 (80)
East	2.4700	26.1244	0.6300	0.7000	1.0000	25.6109 (82)
Solar gains	272.4546	475.2190	682.1172	902.4767	1065.9213	1083.1774
Total gains	984.4083	1211.5313	1384.4469	1586.1203	1713.0826	1708.9518

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	40.0911	40.1236	40.1555	40.3060	40.3343	40.4664	40.4664	40.4910	40.4154	40.3343	40.2771	40.2175
alpha	3.6727	3.6749	3.6770	3.6871	3.6890	3.6978	3.6978	3.6994	3.6944	3.6890	3.6851	3.6812
util living area	0.9917	0.9819	0.9629	0.9119	0.8109	0.6519	0.5021	0.5580	0.7803	0.9411	0.9842	0.9933 (86)
MIT	19.0264	19.3103	19.7024	20.2080	20.6286	20.8824	20.9659	20.9497	20.7622	20.1979	19.5126	18.9691 (87)
Th 2	20.1523	20.1529	20.1535	20.1564	20.1569	20.1595	20.1595	20.1599	20.1585	20.1569	20.1558	20.1547 (88)
util rest of house	0.9902	0.9786	0.9559	0.8947	0.7741	0.5870	0.4154	0.4699	0.7258	0.9262	0.9808	0.9921 (89)
MIT 2	18.3197	18.6020	18.9897	19.4823	19.8728	20.0875	20.1447	20.1365	19.9973	19.4810	18.8068	18.2644 (90)
Living area fraction	18.4046	18.6870	19.0753	19.5695	19.9636	20.1830	20.2433	20.2342	20.0892	19.5671	18.8916	18.3490 (91)
Temperature adjustment	18.4046	18.6870	19.0753	19.5695	19.9636	20.1830	20.2433	20.2342	20.0892	19.5671	18.8916	18.3490 (92)
adjusted MIT	18.4046	18.6870	19.0753	19.5695	19.9636	20.1830	20.2433	20.2342	20.0892	19.5671	18.8916	18.3490 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9857	0.9709	0.9445	0.8806	0.7647	0.5889	0.4244	0.4781	0.7207	0.9131	0.9738	0.9883	(94)
Useful gains	970.3367	1176.3338	1307.6460	1396.6916	1309.9891	1006.4123	693.6620	719.9860	990.6488	1066.7550	974.4032	915.6146	(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	2785.0214	2720.1180	2479.0713	2095.5131	1621.8478	1092.1596	712.7215	749.6084	1173.1125	1759.9305	2317.5566	2785.0154	(97)
Space heating kWh	1350.1254	1037.4230	871.5404	503.1515	232.0228	0.0000	0.0000	0.0000	0.0000	515.7225	967.0704	1390.8342	(98a)
Space heating requirement - total per year (kWh/year)												6867.8903	
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	1350.1254	1037.4230	871.5404	503.1515	232.0228	0.0000	0.0000	0.0000	0.0000	515.7225	967.0704	1390.8342	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6867.8903	
Space heating per m2										(98c) / (4) =		31.9288	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1838.8606	1447.6136	1485.8360	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7935	0.8614	0.8255	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1459.1102	1246.9239	1226.5765	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1869.0107	1787.6411	1645.9392	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	295.1284	402.2936	312.0059	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fc = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	73.7821	100.5734	78.0015	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												252.3570	(107)
Energy for space heating												31.9288	(99)
Energy for space cooling												1.1732	(108)
Total												33.1020	(109)
Fabric Energy Efficiency (DFEE)												33.1	(109)

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

1. Overall dwelling characteristics

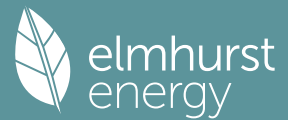
	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	80.6300 (1b)	x 2.3600 (2b)	= 190.2868 (1b) - (3b)	
First floor	80.6300 (1c)	x 2.5500 (2c)	= 205.6065 (1c) - (3c)	
Second floor	53.8400 (1d)	x 2.3900 (2d)	= 128.6776 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	215.1000		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	524.5709 (5)	

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0763 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3263 (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) =	0.2773 (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	0.3536	0.3466	0.3397	0.3050	0.2981	0.2634	0.2634	0.2565	0.2773	0.2981	0.3120	0.3258	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5625	0.5601	0.5577	0.5465	0.5444	0.5347	0.5347	0.5329	0.5385	0.5444	0.5487	0.5531	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opening Type			31.1200	1.1450	35.6336			(27)
TER Roof Light			2.4700	1.5918	4.5741			(27a)
Floor			80.6300	0.1300	10.4819			(28a)
Wall	231.8300	31.1200	200.7100	0.1800	36.1278			(29a)
Studs to Void	41.7000		41.7000	0.1800	7.5060			(29a)
Plane	35.0700		35.0700	0.1100	3.8577			(30)
shPlane	26.7800		26.7800	0.1100	2.9458			(30)
Sloped	24.9300	2.4700	22.4600	0.1100	2.4706			(30)
Total net area of external elements Aum(A, m2)			440.9400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.5975			(33)

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

132.4885 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	22.1000	0.0500	1.1050
E2 Other lintels (including other steel lintels)	22.1000	0.0500	1.1050
E3 Sill	46.9000	0.0500	2.3450
E4 Jamb	40.8200	0.1600	6.5312
E5 Ground floor (normal)	40.8200	0.0000	0.0000
E6 Intermediate floor within a dwelling	44.2600	0.0900	3.9834
E16 Corner (normal)	6.4000	0.0800	0.5120
R11 Upstands or kerbs of rooflights	20.5100	-0.0900	-1.8459
E17 Corner (inverted - internal area greater than external area)	25.3200	0.0600	1.5192
E10 Eaves (insulation at ceiling level)	22.3200	0.0400	0.8928
E11 Eaves (insulation at rafter level)	11.5100	0.0600	0.6906
E12 Gable (insulation at ceiling level)	5.4100	0.0800	0.4328
E13 Gable (insulation at rafter level)	22.5600	0.0600	1.3536
R6 Flat ceiling			

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

18.6247 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 122.2222 (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	97.3749	96.9547	96.5428	94.6084	94.2464	92.5615	92.5615	92.2495	93.2105	94.2464	94.9786	95.7441	(38)
Heat transfer coeff	219.5970	219.1769	218.7650	216.8305	216.4686	214.7837	214.7837	214.4717	215.4327	216.4686	217.2008	217.9662	(39)
Average = Sum(39)m / 12 =												216.8288	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0209	1.0190	1.0170	1.0080	1.0064	0.9985	0.9985	0.9971	1.0015	1.0064	1.0098	1.0133	(40)
HLP (average)												1.0080	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

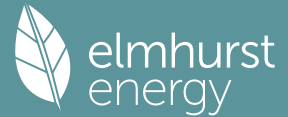
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0216 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	32.3247	31.8446	31.1686	29.9221	28.9888	27.9538	27.3948	28.0661	28.7970	29.9045	31.1766	32.2154	(42b)
Hot water usage for other uses	45.5738	43.9166	42.2593	40.6021	38.9449	37.2876	37.2876	38.9449	40.6021	42.2593	43.9166	45.5738	(42c)
Average daily hot water use (litres/day)												71.4008	(43)
Daily hot water use	77.8985	75.7612	73.4279	70.5242	67.9336	65.2415	64.6824	67.0110	69.3991	72.1638	75.0932	77.7892	(44)
Energy conte	123.3722	107.8829	112.8560	96.5441	91.4517	80.2220	78.2278	82.9736	85.5761	97.9256	106.9840	121.7991	(45)
Energy content (annual)										Total = Sum(45)m =		1185.8150	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss (or HIU loss):													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	104.8663	91.7005	95.9276	82.0625	77.7340	68.1887	66.4936	70.5275	72.7397	83.2367	90.9364	103.5292	(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	104.8663	91.7005	95.9276	82.0625	77.7340	68.1887	66.4936	70.5275	72.7397	83.2367	90.9364	103.5292	(64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		1007.9427	(64)
Electric shower(s)	59.9676	53.4316	58.3453	55.6782	56.7230	54.1082	55.9118	56.7230	55.6782	58.3453	57.2482	59.9676	(64a)
Heat gains from water heating, kWh/month	41.2085	36.2830	38.5682	34.4352	33.6142	30.5742	30.6014	31.8126	32.1045	35.3955	37.0461	40.8742	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	151.0779	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	203.0632	224.8199	203.0632	209.8320	203.0632	209.8320	203.0632	203.0632	209.8320	203.0632	209.8320	203.0632	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	385.1794	389.1764	379.1042	357.6616	330.5943	305.1548	288.1597	284.1627	294.2349	315.6775	342.7448	368.1843	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	38.1078	(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)													

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	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	-120.8623	(71)
Water heating gains (Table 5)	55.3877	53.9926	51.8390	47.8266	45.1804	42.4642	41.1309	42.7589	44.5895	47.5746	51.4530	54.9384	(72)
Total internal gains	711.9537	736.3123	702.3297	683.6436	647.1613	625.7743	600.6771	598.3082	616.9798	634.6386	672.3531	694.5093	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
North	15.6900	10.6334	0.6300		0.7000	0.7700	50.9878 (74)
East	0.9900	19.6403	0.6300		0.7000	0.7700	5.9423 (76)
South	12.4600	46.7521	0.6300		0.7000	0.7700	178.0290 (78)
West	1.9800	19.6403	0.6300		0.7000	0.7700	11.8846 (80)
East	2.4700	26.1244	0.6300		0.7000	1.0000	25.6109 (82)

Solar gains	272.4546	475.2190	682.1172	902.4767	1065.9213	1083.1774	1033.8551	907.6121	757.4934	533.5934	328.3075	231.9205	(83)
Total gains	984.4083	1211.5313	1384.4469	1586.1203	1713.0826	1708.9518	1634.5322	1505.9203	1374.4731	1168.2320	1000.6606	926.4298	(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	36.0487	36.1178	36.1858	36.5086	36.5697	36.8566	36.8566	36.9102	36.7455	36.5697	36.4464	36.3184	
alpha	3.4032	3.4079	3.4124	3.4339	3.4380	3.4571	3.4571	3.4607	3.4497	3.4380	3.4298	3.4212	
util living area	0.9916	0.9827	0.9658	0.9213	0.8327	0.6850	0.5380	0.5935	0.8046	0.9467	0.9847	0.9932 (86)	
MIT	18.7829	19.0725	19.4865	20.0387	20.5145	20.8308	20.9455	20.9230	20.6846	20.0522	19.3188	18.7360 (87)	
Th 2	20.0659	20.0676	20.0692	20.0766	20.0780	20.0846	20.0846	20.0858	20.0820	20.0780	20.0752	20.0722 (88)	
util rest of house	0.9901	0.9794	0.9591	0.9049	0.7962	0.6162	0.4407	0.4965	0.7497	0.9323	0.9813	0.9919 (89)	
MIT 2	18.0165	18.3052	18.7159	19.2593	19.7060	19.9809	20.0612	20.0503	19.8680	19.2815	18.5573	17.9743 (90)	
Living area fraction									FLA = Living area / (4) =				0.1201 (91)
MIT	18.1086	18.3974	18.8084	19.3530	19.8031	20.0830	20.1675	20.1551	19.9661	19.3741	18.6487	18.0658 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.1086	18.3974	18.8084	19.3530	19.8031	20.0830	20.1675	20.1551	19.9661	19.3741	18.6487	18.0658 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9852	0.9713	0.9470	0.8891	0.7837	0.6161	0.4500	0.5044	0.7417	0.9181	0.9738	0.9878 (94)
Useful gains	969.8551	1176.7102	1311.0592	1410.2203	1342.6142	1052.8675	735.5264	759.6067	1019.3933	1072.5916	974.4884	915.1239 (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	3032.3259	2958.3167	2692.6552	2266.5204	1754.0727	1177.6673	766.2329	805.3647	1263.7440	1899.3233	2508.3969	3022.2681 (97)
Space heating kWh	1534.4783	1197.2396	1027.9074	616.5361	306.1251	0.0000	0.0000	0.0000	0.0000	615.0883	1104.4142	1567.7153 (98a)
Space heating requirement - total per year (kWh/year)												7969.5042
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	1534.4783	1197.2396	1027.9074	616.5361	306.1251	0.0000	0.0000	0.0000	0.0000	615.0883	1104.4142	1567.7153 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7969.5042
Space heating per m2										(98c) / (4) =		37.0502 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	2018.9667	1589.3993	1629.9848	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7448	0.8189	0.7796	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1503.7598	1301.5023	1270.7069	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1869.0107	1787.6411	1645.9392	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	262.9806	361.6872	279.1729	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	65.7452	90.4218	69.7932	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												225.9602 (107)
Energy for space heating												37.0502 (99)
Energy for space cooling												1.0505 (108)
Total												38.1007 (109)
Fabric Energy Efficiency (TFEE)												38.1 (109)