

Project No: 23033

North Hertfordshire District Council

Energy & Sustainability Statement

Proposed Replacement Dwelling of The Kennels Building, Hexton Manor, Hexton, SG5
3JG

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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 construction of 1no. replacement dwelling of The Kennels Building, Hexton Manor, Hexton, SG5 3JG.

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.

Predictive SAP 10 calculations firmly demonstrates that the proposed development is predicted to emit at least **57.48%** 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 MCS Approved Air Source Heat Pumps as a means of providing the dwelling with heating and hot water from a low carbon source.

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

In the circumstances, the proposed development is deemed to satisfy the requirements of Condition 8 of North Hertfordshire District Council's Planning Approval dated 16th December 2024 (24/02845/FP) by complying with the requirements of Policies SP9 and D1 of the Local Plan (November 2022).

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1.0 Introduction

- 1.1 EPS Group have been appointed to discharge Condition 8 of the planning approval dated 16th December 2024 (24/02845/FP) in respect to the proposed construction of 1no. replacement dwelling of The Kennels Building, Hexton Manor, Hexton, SG5 3JG.
- 1.2 The proposed works are required 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 carbon dioxide (CO₂) emissions of the development.
- 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)
Grid supplied electricity	0.136
Grid displaced electricity	0.136

- 1.5 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:

"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 North Hertfordshire District Council

Policies SP9: *Design and Sustainability* and D1: *Sustainable Design* of North Hertfordshire Council's *Local Plan* (November 2022) encourages good design and sustainable development. Of particular relevance is that buildings are required to be designed in order reduce energy consumption and to have a positive influence on the environment. Developers are encouraged to seek to minimise carbon emissions and maximise opportunities for energy generation from renewable sources. Specifically, the policies state:

"Policy SP9: Design and Sustainability

The Council considers good design to be a key aspect of sustainable development. We will:

- a) *Support new development where it is well designed and located and responds positively to its local context;*
- b) *Require Strategic Masterplans to be produced for Strategic Housing Sites and other significant development. Significant development generally comprises residential development of 100 dwellings or more. Exceptionally,*

developments under 100 dwellings will be considered significant if there are site specific complexities and sensitivities that require a masterplan-led approach. In some circumstances a Strategic Masterplan may also be required to consider the cumulative impact of more than one site to support a co-ordinated and integrated approach to place-making and design.

c) Require Strategic Masterplans and planning applications for Strategic Housing Sites and significant development to (as applicable):

create buildings, spaces and streets which positively reflect and respond to the local landscape, townscape and historic character

- *create integrated, accessible and sustainable transport systems with walking, cycling and public transport designed to be the most attractive forms of transport and effectively linking into the surrounding areas;*
- *provide a clear structure and hierarchy of pedestrian friendly streets and well-connected footpaths and cycleways integrate with the wider built and natural environment and communities;*
- *plan for integrated and mixed-use communities with walkable locally accessible community, employment and retail facilities;*
- *positively integrate with adjacent rural and urban communities and positively contribute to their character and the way the area functions, including addressing cumulative, cross boundary planning and infrastructure matters;*
- *create an accessible multi-functional green infrastructure network that provides:*
 - a) a key structuring and functional place-making feature supporting healthy lifestyles, sport, play and recreation linking into the wider Green Infrastructure Network; and*
 - b) a high-quality integrated network to support ecological connectivity, biodiversity net gain, climate adaptation and mitigation linking into the wider Ecological Network*
- *ensure the effective use of sustainable urban drainage and sustainable water management;*
- *ensure a hierarchy of linked, high quality and attractive public spaces and public realm that is safe, attractive and supports social interaction for all age groups; and*
- *design to last with a clear stewardship, management and maintenance strategy*

d) Ensure Strategic Masterplans are informed by a technical and design evidence base and include the following for Strategic Housing Sites and where applicable for other significant development:

- *site specific vision and place-making principles*
- *Masterplan setting out the quantum, scale, type, mix and distribution of land uses, housing and community facilities;*
- *Green Infrastructure Framework identifying the scale, distribution, type and design of green spaces, biodiversity net gain, strategic drainage and on and off-site linkages;*
- *Movement Framework setting out the key access points, strategic highways, street hierarchy and footways and cycleways (on and off site)*
- *Urban Design Framework and design principles identifying how the site responds to local character and context and key structuring elements and layout principles (including heights and densities)*

- *Sustainability & Energy Framework identifying site-wide and building scale opportunities for low and zero carbon vii. Illustrative Masterplan Layout*
- *Infrastructure Delivery, Phasing & Management Strategy*
 - e) *Encourage the submission of Strategic Masterplans for the Council's consideration and agreement before the submission of a planning application. We will also confirm the scope and contents of individual Strategic Masterplans with applicants in pre-application discussions. Planning applications must be accompanied by a Strategic Masterplan. Where applications have already been submitted to the Council a Strategic Masterplan should be agreed with the Council prior to or as part of the grant of planning permission. Adherence to the Strategic Masterplan will be secured through planning conditions and/or legal agreement.*
 - f) *Assess proposals against detailed policy requirements set out in this Plan and have regard to the Design SPD; and*
 - g) *Adopt the Government's additional technical standards for the size of new homes, water efficiency and, in specified circumstances, accessibility.*

Policy D1: Sustainable design:

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:*
 - *create or enhance public realm;*
 - *optimise the potential of the site by incorporating Sustainable Drainage Systems (SuDS);*
 - *reduce energy consumption and waste;*
 - *retain existing vegetation and propose appropriate new planting;*
 - *maximise accessibility, legibility and physical and social connectivity*
 - *both internally and with neighbouring areas;*
 - *future proof for changes in technology and lifestyle;*
 - *design-out opportunities for crime and anti-social behaviour; and*
 - *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 North Hertfordshire District Council's Planning Approval (24/02845/FP)

On the 16th December 2024, North Hertfordshire District Council approved the proposed development with the following relevant condition:

"Prior to commencement a site-wide sustainability strategy shall be submitted to the Local Planning Authority for approval addressing renewable energy, reducing carbon emissions and water conservation.

Reason To reduce carbon dioxide emissions and promoting principles of sustainable construction and the efficient use of buildings in accordance with Policies SP9 and D1 in the local plan."

2.4 Conclusions

On review of the above planning policies and moreover Condition 8 of North Hertfordshire District Council's planning approval, 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 development benefits from a range of passive design features including internal layouts that facilitate 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 development 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
External Wall U-value	0.26 W/m ² K	0.17 W/m²K
Ground Floor U-value	0.18 W/m ² K	0.12 W/m²K
Insulated Rafter U-value	0.16 W/m ² K	0.13 W/m²K
Glazing U-value	1.60 W/m ² K	1.40 W/m²K
Entrance Door U-value	1.60 W/m ² K	1.20 W/m²K
Air Permeability	8.00 m ³ /m ² .h	5.00 m³/m².h
Thermal Bridging	-	Recognised Construction Details
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 Radiators and Underfloor Heating with a design flow temperature of 55°C
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 development 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 development 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 nor in keeping with the local area. - The site is sheltered by trees on the northern boundary 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. - Easy to integrate into a conventional build specification or retrofit applications. - The dwelling benefits from south-facing pitched roof space to the rear, which would provide optimal PV conditions
Site Limitations / Restrictions	- PV panels are not aesthetically pleasing and may detract from the visual appearance of the dwelling. - The installation of the solar PV arrays would not be in keeping with the style of the site surrounding the development - 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 not 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. - As with PV, the south-facing pitched roof would provide optimal location for the siting of a small number of solar collectors to maximise their efficiency.
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. - The installation of the solar PV arrays would not be in keeping with the style of the site surrounding the development - Solar collectors are not aesthetically pleasing and may detract from the visual appearance of the development.
Conclusion	It is not proposed to use this technology within the proposed development.

4.5 Ground Source Heat Pump

Benefits	• High operating efficiencies (CoPs). • Flexible installation options for new build developments, 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. • 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 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. • 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 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 MCS Approved Air Source Heat Pumps (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 systems will be designed, tested and commissioned to current approved standards.

5.0 Calculated Energy Performance (Illustrative)

- 5.1 Having identified the use of Air Source Heat Pumps as being the most suitable low carbon technology for use within the development, predictive SAP 10 calculations have been prepared for the development based upon the 'Lean' specifications outlined within Section 3 of this report, including the Air Source Heat Pump as the primary source of heating and hot water.
- 5.2 The results of the illustrative SAP Calculations 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
154.69	9.98	1,543.55	4.24	656.38	57.48%

- 5.3 On review of the above, it is evident that the proposed dwelling will achieve a minimum reduction in regulated CO₂ emissions of **57.48%** in comparison to Approved Document L1 2021 of the Building Regulations.

6.0 Flood Risk and Water Management

- 6.1 The development 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 each dwelling with an overall reduced water consumption of less than or equal to 110 litres per person per day in line with the lower 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 is still to be confirmed, an example specification is detailed below, which will be used as a baseline for the development:
- 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 meters 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 development is located in Flood Risk Zone 1, which is an area that is not at risk of flooding.
- 6.5 In the circumstances, the proposed development is deemed to satisfy the requirements of Condition 8 of North Hertfordshire District Council's Planning Approval dated 16th December 2024 (24/02845/FP) by complying with the requirements of Policies SP9 and D1 of the Local Plan (November 2022).



Appendix 1:

Baseline TER and Renewable DER Calculations (SAP Derived)

Full SAP Calculation Printout



Property Reference	23033			Issued on Date	03/10/2025	
Assessment Reference	Renewable	Prop Type Ref	EST			
Property	The Kennels Building, Hexton Manor, Hexton, SG5 3JG					
SAP Rating	79 C	DER	4.24	TER	9.98	
Environmental	96 A	% DER < TER				57.52
CO ₂ Emissions (t/year)	0.6	DFEE	42.18	TFEE	43.45	
Compliance Check	See BREL	% DFEE < TFEE				2.93
% DPER < TPER	15.93	DPER	44.02	TPER	52.36	
Assessor Details	Mr. Samuel Marks			Assessor ID	BP82-0001	
Client	19121, Richard Chambers					

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	77.9500 (1b)	x 2.3200 (2b)	= 180.8440 (1b) - (3b)
First floor	76.7400 (1c)	x 2.8200 (2c)	= 216.4068 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	154.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 397.2508 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1007 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3507 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3244 (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	0.4136	0.4055	0.3974	0.3568	0.3487	0.3082	0.3082	0.3001	0.3244	0.3487	0.3649	0.3812 (22b)
Effective ac	0.5855	0.5822	0.5790	0.5637	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5666	0.5726 (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			28.6900	1.3258	38.0360		(27)
Half Glazed Door			2.1000	1.2000	2.5200		(26a)
Floor			77.9500	0.1200	9.3540	75.0000	5846.2500 (28a)
External Wall	219.9600	30.7900	189.1700	0.1700	32.1589	60.0000	11350.2000 (29a)
Dormer Wall	1.4400		1.4400	0.1500	0.2160	9.0000	12.9600 (29a)
Flat	1.2100		1.2100	0.1500	0.1815	9.0000	10.8900 (30)
Plane	61.2700		61.2700	0.1100	6.7397	9.0000	551.4300 (30)
Sloped	21.8800		21.8800	0.1300	2.8444	9.0000	196.9200 (30)
Total net area of external elements Aum(A, m ²)			383.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0505		(33)
Main dwelling							
BG			77.1200			75.0000	5784.0000 (32c)
TG			16.6100			9.0000	149.4900 (32c)
B1			93.7400			75.0000	7030.5000 (32c)
T1			10.1000			9.0000	90.9000 (32c)
Internal Floor			76.7400			18.0000	1381.3200 (32d)
Internal Ceiling			76.7400			9.0000	690.6600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	33095.5200 (34)

Full SAP Calculation Printout



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

213.9474 (35)

List of Thermal Bridges

K1 Element
E2 Other lintels (including other steel lintels)
E3 Sill
E4 Jamb
E5 Ground floor (normal)
E6 Intermediate floor within a dwelling
E16 Corner (normal)
E17 Corner (inverted - internal area greater than external area)
E11 Eaves (insulation at rafter level)
E12 Gable (insulation at ceiling level)
E13 Gable (insulation at rafter level)
E14 Flat roof
R6 Flat ceiling
E10 Eaves (insulation at ceiling level)
R7 Flat ceiling (inverted)
R5 Ridge (inverted)

Length	Psi-value	Total
22.1000	0.0220	0.4862
21.1000	0.0190	0.4009
56.1000	0.0140	0.7854
45.9600	0.0730	3.3551
47.0700	0.0010	0.0471
46.2000	0.0440	2.0328
23.0200	-0.0790	-1.8186
23.3800	0.0180	0.4208
16.6200	0.0560	0.9307
6.7900	0.0410	0.2784
3.2400	0.1600	0.5184
28.1800	0.1200	3.3816
4.8000	0.0620	0.2976
6.7900	0.1200	0.8148
4.1600	0.1200	0.4992

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

12.4304 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 104.4809 (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	76.7589	76.3235	75.8968	73.8922	73.5172	71.7713	71.7713	71.4480	72.4438	73.5172	74.2759	75.0691
Heat transfer coeff	181.2398	180.8044	180.3777	178.3731	177.9981	176.2522	176.2522	175.9289	176.9247	177.9981	178.7568	179.5500
Average = Sum(39)m / 12 =												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1716	1.1688	1.1661	1.1531	1.1507	1.1394	1.1394	1.1373	1.1437	1.1507	1.1556	1.1607
HLP (average)												
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9413 (42)
Hot water usage for mixer showers												
101.1113	99.5918	97.3776	93.1411	90.0147	86.5281	84.5463	86.7438	89.1526	92.8961	97.2236	100.7239	(42a)
Hot water usage for baths												
31.7459	31.2744	30.6105	29.3863	28.4697	27.4533	26.9043	27.5635	28.2814	29.3690	30.6184	31.6386	(42b)
Hot water usage for other uses												
44.7517	43.1244	41.4970	39.8697	38.2424	36.6150	36.6150	38.2424	39.8697	41.4970	43.1244	44.7517	(42c)
Average daily hot water use (litres/day)												163.3381 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	177.6089	173.9906	169.4851	162.3971	156.7267	150.5964	148.0656	152.5497	157.3037	163.7621	170.9664	177.1142
Energy conte	281.2891	247.7603	260.4923	222.3135	210.9843	185.1758	179.0725	188.8884	193.9712	222.2237	243.5729	277.3181
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												
42.1934	37.1640	39.0739	33.3470	31.6476	27.7764	26.8609	28.3333	29.0957	33.3336	36.5359	41.5977	(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												
343.0535	303.5475	322.2567	282.0855	272.7487	244.9478	240.8369	250.6528	253.7432	283.9881	303.3449	339.0825	(62)
WWHRS	-79.9315	-70.6921	-74.0247	-61.2954	-57.1251	-48.8823	-45.8194	-48.7243	-50.5756	-59.6230	-67.5456	(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	263.1220	232.8554	248.2320	220.7902	215.6236	196.0655	195.0175	201.9284	203.1676	224.3651	235.7993	260.6311
12Total per year (kWh/year)												2697.5977 (64)
Electric shower(s)												2698 (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	142.9402	127.0101	136.0252	121.7369	119.5638	109.3886	108.9531	112.2169	112.3130	123.3009	128.8056	141.6198
												(65)

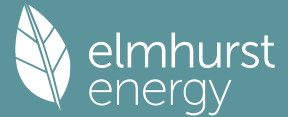
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(66)m	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
166.9575	184.8458	166.9575	172.5228	166.9575	172.5228	166.9575	166.9575	172.5228	166.9575	172.5228	166.9575	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
325.5790	328.9575	320.4438	302.3191	279.4400	257.9369	243.5715	240.1930	248.7067	266.8313	289.7104	311.2136	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	(71)
Water heating gains (Table 5)												
192.1239	189.0031	182.8296	169.0790	160.7040	151.9286	146.4424	150.8292	155.9903	165.7270	178.8967	190.3492	(72)
Total internal gains	754.7796	772.9256	740.3502	714.0401	677.2209	649.5075	624.0907	625.0990	644.3391	669.6351	711.2491	738.6395
												(73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
North	11.8800	10.6334	0.6300	0.7000	0.7700	38.6065 (74)
East	0.5300	19.6403	0.6300	0.7000	0.7700	3.1812 (76)
South	15.7500	46.7521	0.6300	0.7000	0.7700	225.0366 (78)
West	0.5300	19.6403	0.6300	0.7000	0.7700	3.1812 (80)

Solar gains	270.0055	454.7772	615.3356	761.8708	860.8264	860.0166	826.7372	750.6747	664.9894	500.1107	322.3044	231.8688 (83)
Total gains	1024.7852	1227.7029	1355.6858	1475.9110	1538.0473	1509.5241	1450.8279	1375.7737	1309.3285	1169.7458	1033.5536	970.5083 (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	50.7239	50.8461	50.9664	51.5392	51.6478	52.1594	52.1594	52.2552	51.9611	51.6478	51.4285	51.2013
alpha	4.3816	4.3897	4.3978	4.4359	4.4432	4.4773	4.4773	4.4837	4.4641	4.4432	4.4286	4.4134
util living area	0.9942	0.9868	0.9724	0.9329	0.8450	0.6830	0.5190	0.5645	0.7873	0.9478	0.9879	0.9954 (86)
MIT	19.7568	19.9365	20.1713	20.4722	20.7217	20.8739	20.9176	20.9118	20.8191	20.4949	20.0725	19.7298 (87)
Th 2	19.9428	19.9450	19.9472	19.9577	19.9597	19.9688	19.9688	19.9705	19.9653	19.9597	19.9557	19.9516 (88)
util rest of house	0.9926	0.9831	0.9643	0.9123	0.7974	0.5955	0.4048	0.4491	0.7116	0.9275	0.9838	0.9941 (89)
MIT 2	18.4899	18.7199	19.0180	19.3974	19.6869	19.8445	19.8753	19.8742	19.7965	19.4331	18.9028	18.4621 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	18.6623	18.8855	19.1750	19.5437	19.8277	19.9846	20.0171	20.0154	19.9356	19.5776	19.0620	18.6346 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.6623	18.8855	19.1750	19.5437	19.8277	19.9846	20.0171	20.0154	19.9356	19.5776	19.0620	18.6346 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9897	0.9780	0.9565	0.9023	0.7905	0.5970	0.4103	0.4544	0.7091	0.9180	0.9789	0.9918 (94)
Useful gains	1014.2571	1200.6680	1296.7617	1331.7060	1215.7622	901.1564	595.3421	625.1364	928.4705	1073.7980	1011.7887	962.5162 (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	2603.0171	2528.6375	2286.2796	1898.5465	1446.7178	949.0402	602.2742	636.0535	1032.4684	1597.9880	2138.2818	2591.7359 (97)
Space heating kWh	1182.0375	892.3954	736.2013	408.1252	171.8309	0.0000	0.0000	0.0000	0.0000	389.9974	811.0750	1212.1395 (98a)
Space heating requirement - total per year (kWh/year)												5803.8022
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	1182.0375	892.3954	736.2013	408.1252	171.8309	0.0000	0.0000	0.0000	0.0000	389.9974	811.0750	1212.1395 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5803.8022
Space heating per m2												(98c) / (4) = 37.5189 (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 %)												219.3000 (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	1182.0375	892.3954	736.2013	408.1252	171.8309	0.0000	0.0000	0.0000	0.0000	389.9974	811.0750	1212.1395 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	539.0048	406.9291	335.7051	186.1036	78.3543	0.0000	0.0000	0.0000	0.0000	177.8374	369.8473	552.7312 (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	263.1220	232.8554	248.2320	220.7902	215.6236	196.0655	195.0175	201.9284	203.1676	224.3651	235.7993	260.6311 (64)
Water heating requirement	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (217)
Fuel for water heating, kWh/month	138.1943	122.2980	130.3740	115.9612	113.2477	102.9756	102.4252	106.0548	106.7057	117.8388	123.8442	136.8861 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
(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	39.2602	31.4960	28.3586	20.7767	16.0485	13.1118	14.6400	19.0297	24.7176	32.4309	36.6306	40.3513 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												2646.5126 (211)
Space heating fuel - main system 1												

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Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1416.8055	(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)	316.8520	(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	4380.1701	(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	2646.5126	0.1555	411.4129	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1416.8055	0.1406	199.2332	(264)
Space and water heating			610.6461	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	316.8520	0.1443	45.7315	(268)
Total CO2, kg/year			656.3776	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.2400	(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	2646.5126	1.5755	4169.6308	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1416.8055	1.5200	2153.4777	(278)
Space and water heating			6323.1085	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	316.8520	1.5338	485.9981	(282)
Total Primary energy kWh/year			6809.1066	(286)
Dwelling Primary energy Rate (DPER)			44.0200	(287)

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

1. Overall dwelling characteristics

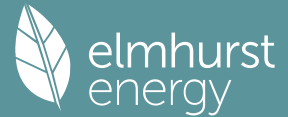
	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	77.9500 (1b)	x 2.3200 (2b)	= 180.8440 (1b)	- (3b)
First floor	76.7400 (1c)	x 2.8200 (2c)	= 216.4068 (1c)	- (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	154.6900			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 397.2508	(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) =	0.1007 (8)
Pressure test	Yes		
Pressure Test Method	Blower Door		
Measured/design AP50	5.0000		(17)
Infiltration rate	0.3507		(18)
Number of sides sheltered	1		(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3244	(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
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
Adj infilt rate	0.4136	0.4055	0.3974	0.3568	0.3487	0.3082	0.3082	0.3001	0.3244	0.3487	0.3649	0.3812
Effective ac	0.5855	0.5822	0.5790	0.5637	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5666	0.5726

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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 Semi-glazed door			2.1000	1.0000	2.1000			(26a)
TER Opening Type			28.6900	1.1450	32.8511			(27)
Floor			77.9500	0.1300	10.1335			(28a)
External Wall	219.9600	30.7900	189.1700	0.1800	34.0506			(29a)
Dormer Wall	1.4400		1.4400	0.1800	0.2592			(29a)
Flat	1.2100		1.2100	0.1100	0.1331			(30)
Plane	61.2700		61.2700	0.1100	6.7397			(30)
Sloped	21.8800		21.8800	0.1100	2.4068			(30)
Total net area of external elements Aum(A, m2)			383.7100					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	88.6740		(33)

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

213.9474 (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	21.1000	0.0500	1.0550
E4 Jamb	56.1000	0.0500	2.8050
E5 Ground floor (normal)	45.9600	0.1600	7.3536
E6 Intermediate floor within a dwelling	47.0700	0.0000	0.0000
E16 Corner (normal)	46.2000	0.0900	4.1580
E17 Corner (inverted - internal area greater than external area)	23.0200	-0.0900	-2.0718
E11 Eaves (insulation at rafter level)	23.3800	0.0400	0.9352
E12 Gable (insulation at ceiling level)	16.6200	0.0600	0.9972
E13 Gable (insulation at rafter level)	6.7900	0.0800	0.5432
E14 Flat roof	3.2400	0.0800	0.2592
R6 Flat ceiling	28.1800	0.0600	1.6908
E10 Eaves (insulation at ceiling level)	4.8000	0.0600	0.2880
R7 Flat ceiling (inverted)	6.7900	0.0400	0.2716
R5 Ridge (inverted)	4.1600	0.0400	0.1664

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

19.5564 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 108.2304 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	76.7589	76.3235	75.8968	73.8922	73.5172	71.7713	71.7713	71.4480	72.4438	73.5172	74.2759	75.0691	(38)
Heat transfer coeff	184.9894	184.5540	184.1272	182.1227	181.7476	180.0017	180.0017	179.6784	180.6742	181.7476	182.5063	183.2995	(39)
Average = Sum(39)m / 12 =												182.1209	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.1959	1.1931	1.1903	1.1773	1.1749	1.1636	1.1636	1.1615	1.1680	1.1749	1.1798	1.1849	(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													2.9413 (42)
Hot water usage for mixer showers	73.5355	72.4304	70.8201	67.7390	65.4652	62.9295	61.4882	63.0864	64.8383	67.5608	70.7081	73.2538 (42a)	
Hot water usage for baths	31.7459	31.2744	30.6105	29.3863	28.4697	27.4533	26.9043	27.5635	28.2814	29.3690	30.6184	31.6386 (42b)	
Hot water usage for other uses	44.7517	43.1244	41.4970	39.8697	38.2424	36.6150	36.6150	38.2424	39.8697	41.4970	43.1244	44.7517 (42c)	
Average daily hot water use (litres/day)												137.9141 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.0331	146.8292	142.9276	136.9950	132.1773	126.9978	125.0075	128.8923	132.9893	138.4268	144.4508	149.6440 (44)	
Energy conte	237.6158	209.0828	219.6744	187.5393	177.9360	156.1586	151.1858	159.5956	163.9892	187.8439	205.7967	234.3064 (45)	
Energy content (annual)										Total = Sum(45)m =		2290.7245	
Distribution loss (46)m = 0.15 x (45)m													
	35.6424	31.3624	32.9512	28.1309	26.6904	23.4238	22.6779	23.9393	24.5984	28.1766	30.8695	35.1460 (46)	
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.9188 (55)	
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)	
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month													
	289.3624	255.8217	271.4210	237.6167	229.6826	206.2360	202.9324	211.3422	214.0665	239.5905	255.8740	286.0530 (62)	
WWHRS	-33.6174	-29.7315	-31.1331	-25.7794	-24.0255	-20.5588	-19.2706	-20.4923	-21.2709	-25.0761	-28.4081	-32.9948 (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													
	255.7450	226.0902	240.2879	211.8372	205.6571	185.6772	183.6618	190.8498	192.7956	214.5144	227.4659	253.0582 (64)	
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2587.6403 (64)	
Electric shower(s)												2588 (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													
	120.4045	106.9111	114.4390	102.4187	100.5610	91.9846	91.6665	94.4628	94.5883	103.8554	108.4893	119.3042 (65)	

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

Metabolic gains (Table 5), Watts													
(66)m	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	166.9575	184.8458	166.9575	172.5228	166.9575	172.5228	166.9575	172.5228	166.9575	172.5228	166.9575	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	325.5790	328.9575	320.4438	302.3191	279.4400	257.9369	243.5715	240.1930	248.7067	266.8313	289.7104	311.2136 (68)
Pumps, fans	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514 (71)
Total internal gains	161.8340	159.0939	153.8159	142.2482	135.1626	127.7564	123.2077	126.9661	131.3726	139.5906	150.6795	160.3550 (72)
	724.4898	743.0165	711.3364	687.2094	651.6795	625.3354	600.8560	601.2359	619.7214	643.4987	683.0320	708.6454 (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					11.8800	10.6334		0.6300	0.7000	0.7700		38.6065 (74)
East					0.5300	19.6403		0.6300	0.7000	0.7700		3.1812 (76)
South					15.7500	46.7521		0.6300	0.7000	0.7700		225.0366 (78)
West					0.5300	19.6403		0.6300	0.7000	0.7700		3.1812 (80)
Solar gains	270.0055	454.7772	615.3356	761.8708	860.8264	860.0166	826.7372	750.6747	664.9894	500.1107	322.3044	231.8688 (83)
Total gains	994.4953	1197.7937	1326.6721	1449.0802	1512.5059	1485.3520	1427.5932	1351.9107	1284.7108	1143.6094	1005.3364	940.5142 (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	49.6958	49.8131	49.9285	50.4781	50.5822	51.0728	51.0728	51.1647	50.8827	50.5822	50.3720	50.1540
alpha	4.3131	4.3209	4.3286	4.3652	4.3721	4.4049	4.4049	4.4110	4.3922	4.3721	4.3581	4.3436
util living area	0.9949	0.9881	0.9750	0.9386	0.8561	0.6995	0.5356	0.5822	0.8021	0.9529	0.9892	0.9960 (86)
MIT	19.3729	19.6140	19.9324	20.3439	20.6923	20.9119	20.9786	20.9692	20.8315	20.3772	19.8010	19.3360 (87)
Th 2	19.9233	19.9256	19.9278	19.9382	19.9401	19.9492	19.9492	19.9509	19.9457	19.9401	19.9362	19.9321 (88)
util rest of house	0.9934	0.9847	0.9675	0.9192	0.8098	0.6109	0.4168	0.4627	0.7273	0.9341	0.9855	0.9948 (89)
MIT 2	18.0320	18.3403	18.7444	19.2611	19.6677	19.8936	19.9413	19.9384	19.8239	19.3117	18.5876	17.9909 (90)
Living area fraction	fLA = Living area / (4) = 0.1361 (91)											
MIT	18.2145	18.5136	18.9061	19.4085	19.8072	20.0322	20.0825	20.0787	19.9610	19.4567	18.7528	18.1739 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.2145	18.5136	18.9061	19.4085	19.8072	20.0322	20.0825	20.0787	19.9610	19.4567	18.7528	18.1739 (93)

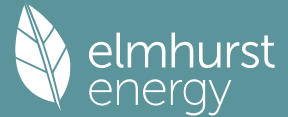
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9898	0.9783	0.9578	0.9070	0.8031	0.6185	0.4325	0.4781	0.7285	0.9227	0.9795	0.9918 (94)
Ext temp.	984.3336	1171.7605	1270.6436	1314.2968	1214.6286	918.6561	617.3722	646.2858	935.9125	1055.2424	984.7231	932.8097 (95)
Heat loss rate W	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)
Space heating kWh	2574.0274	2512.4405	2284.2919	1913.8329	1473.4566	977.8061	626.8495	660.9766	1058.9282	1609.6851	2126.7020	2561.4106 (97)
Space heating requirement - total per year (kWh/year)	1182.7322	900.9370	754.1544	431.6660	192.5680	0.0000	0.0000	0.0000	0.0000	412.5054	822.2248	1211.6790 (98a)
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)	1182.7322	900.9370	754.1544	431.6660	192.5680	0.0000	0.0000	0.0000	0.0000	412.5054	822.2248	1211.6790 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	5908.4668											
Space heating per m2	(98c) / (4) = 38.1955 (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)											
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating efficiency (main heating system 1)	1182.7322	900.9370	754.1544	431.6660	192.5680	0.0000	0.0000	0.0000	0.0000	412.5054	822.2248	1211.6790 (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)	1281.4000	976.0964	817.0687	467.6771	208.6327	0.0000	0.0000	0.0000	0.0000	446.9181	890.8178	1312.7617 (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												
Water heating requirement	255.7450	226.0902	240.2879	211.8372	205.6571	185.6772	183.6618	190.8498	192.7956	214.5144	227.4659	253.0582 (64)
Efficiency of water heater (217)m	87.0544	86.8354	86.4443	85.6211	83.9126	79.8000	79.8000	79.8000	79.8000	85.5010	86.6815	79.8000 (216)
Fuel for water heating, kWh/month	293.7759	260.3665	277.9686	247.4123	245.0850	232.6782	230.1526	239.1602	241.5985	250.8912	262.4156	290.5282 (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)

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Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	34.6905	27.8300	25.0578	18.3584	14.1806	11.5857	12.9360	16.8147	21.8406	28.6561	32.3670	35.6546	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-67.4217	-92.3673	-129.0213	-140.7653	-148.1520	-136.8587	-134.9961	-129.0859	-118.3116	-103.3798	-73.0894	-58.5951	(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	-46.7125	-97.1326	-191.0719	-284.2204	-373.2825	-374.2853	-370.0332	-314.5884	-232.1972	-138.1620	-62.1036	-37.0402	(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												6401.3725	(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												3072.0329	(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)												279.9720	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3852.8740	(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												5986.5033	(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	6401.3725	0.2100	1344.2882 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3072.0329	0.2100	645.1269 (264)
Space and water heating			1989.4151 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	279.9720	0.1443	40.4086 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1332.0442	0.1352	-180.1407
PV Unit electricity exported	-2520.8298	0.1262	-318.0621
Total			-498.2028 (269)
Total CO2, kg/year			1543.5502 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9800 (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	6401.3725	1.1300	7233.5509 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3072.0329	1.1300	3471.3972 (278)
Space and water heating			10704.9480 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	279.9720	1.5338	429.4304 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1332.0442	1.4998	-1997.8618
PV Unit electricity exported	-2520.8298	0.4632	-1167.5363
Total			-3165.3981 (283)
Total Primary energy kWh/year			8099.0811 (286)
Target Primary Energy Rate (TPER)			52.3600 (287)

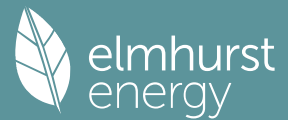
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	77.9500 (1b)	x 2.3200 (2b)	= 180.8440 (1b) - (3b)
First floor	76.7400 (1c)	x 2.8200 (2c)	= 216.4068 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	154.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 397.2508 (5)

2. Ventilation rate

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	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) =	0.1007	(8)
Pressure test				Yes		
Pressure Test Method				Blower Door		
Measured/design AP50					5.0000	(17)
Infiltration rate					0.3507	(18)
Number of sides sheltered					1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3244	(21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.4136	0.4055	0.3974	0.3568	0.3487	0.3082	0.3082	0.3001	0.3244	0.3487	0.3649	0.3812	(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	0.5855	0.5822	0.5790	0.5637	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5666	0.5726	(25)

3. Heat losses and heat loss parameter

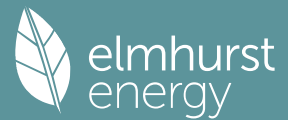
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Window			28.6900	1.3258	38.0360			(27)
Half Glazed Door			2.1000	1.2000	2.5200			(26a)
Floor			77.9500	0.1200	9.3540	75.0000	5846.2500	(28a)
External Wall	219.9600	30.7900	189.1700	0.1700	32.1589	60.0000	11350.2000	(29a)
Dormer Wall	1.4400		1.4400	0.1500	0.2160	9.0000	12.9600	(29a)
Flat	1.2100		1.2100	0.1500	0.1815	9.0000	10.8900	(30)
Plane	61.2700		61.2700	0.1100	6.7397	9.0000	551.4300	(30)
Sloped	21.8800		21.8800	0.1300	2.8444	9.0000	196.9200	(30)
Total net area of external elements Aum(A, m2)			383.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.0505			(33)
Main dwelling								
BG			77.1200			75.0000	5784.0000	(32c)
TG			16.6100			9.0000	149.4900	(32c)
B1			93.7400			75.0000	7030.5000	(32c)
T1			10.1000			9.0000	90.9000	(32c)
Internal Floor			76.7400			18.0000	1381.3200	(32d)
Internal Ceiling			76.7400			9.0000	690.6600	(32e)
Heat capacity Cm = Sum(A x k)								(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								(35)
List of Thermal Bridges								
K1 Element				Length	Psi-value		Total	
E2 Other lintels (including other steel lintels)				22.1000	0.0220		0.4862	
E3 Sill				21.1000	0.0190		0.4009	
E4 Jamb				56.1000	0.0140		0.7854	
E5 Ground floor (normal)				45.9600	0.0730		3.3551	
E6 Intermediate floor within a dwelling				47.0700	0.0010		0.0471	
E16 Corner (normal)				46.2000	0.0440		2.0328	
E17 Corner (inverted - internal area greater than external area)				23.0200	-0.0790		-1.8186	
E11 Eaves (insulation at rafter level)				23.3800	0.0180		0.4208	
E12 Gable (insulation at ceiling level)				16.6200	0.0560		0.9307	
E13 Gable (insulation at rafter level)				6.7900	0.0410		0.2784	
E14 Flat roof				3.2400	0.1600		0.5184	
R6 Flat ceiling				28.1800	0.1200		3.3816	
E10 Eaves (insulation at ceiling level)				4.8000	0.0620		0.2976	
R7 Flat ceiling (inverted)				6.7900	0.1200		0.8148	
R5 Ridge (inverted)				4.1600	0.1200		0.4992	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								(36)
Point Thermal bridges								(36a) =
Total fabric heat loss								(33) + (36) + (36a) =

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	33095.5200	(34)										
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		213.9474	(35)										
List of Thermal Bridges													
K1 Element	Length	Psi-value	Total										
E2 Other lintels (including other steel lintels)	22.1000	0.0220	0.4862										
E3 Sill	21.1000	0.0190	0.4009										
E4 Jamb	56.1000	0.0140	0.7854										
E5 Ground floor (normal)	45.9600	0.0730	3.3551										
E6 Intermediate floor within a dwelling	47.0700	0.0010	0.0471										
E16 Corner (normal)	46.2000	0.0440	2.0328										
E17 Corner (inverted - internal area greater than external area)	23.0200	-0.0790	-1.8186										
E11 Eaves (insulation at rafter level)	23.3800	0.0180	0.4208										
E12 Gable (insulation at ceiling level)	16.6200	0.0560	0.9307										
E13 Gable (insulation at rafter level)	6.7900	0.0410	0.2784										
E14 Flat roof	3.2400	0.1600	0.5184										
R6 Flat ceiling	28.1800	0.1200	3.3816										
E10 Eaves (insulation at ceiling level)	4.8000	0.0620	0.2976										
R7 Flat ceiling (inverted)	6.7900	0.1200	0.8148										
R5 Ridge (inverted)	4.1600	0.1200	0.4992										
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.4304 (36)										
Point Thermal bridges		(36a) =	0.0000										
Total fabric heat loss		(33) + (36) + (36a) =	104.4809 (37)										
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	76.7589	76.3235	75.8968	73.8922	73.5172	71.7713	71.7713	71.4480	72.4438	73.5172	74.2759	75.0691	(38)
	181.2398	180.8044	180.3777	178.3731	177.9981	176.2522	176.2522	175.9289	176.9247	177.9981	178.7568	179.5500	(39)
Average = Sum(39)m / 12 =												178.3713	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9413	(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	0.0000	(42a)
Hot water usage for baths	31.7459	31.2744	30.6105	29.3863	28.4697	27.4533	26.9043	27.5635	28.2814	29.3690	30.6184	31.6386		(42b)
Hot water usage for other uses	44.7517	43.1244	41.4970	39.8697	38.2424	36.6150	36.6150	38.2424	39.8697	41.4970	43.1244	44.7517		(42c)
Average daily hot water use (litres/day)												70.1168		(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	76.4976	74.3988	72.1075	69.2560	66.7120	64.0683	63.5193	65.8059	68.1511	70.8660	73.7427	76.3903		(44)

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Energy content (annual)	121.1535	105.9429	110.8266	94.8080	89.8072	78.7794	76.8211	81.4815	84.0371	96.1645	105.0600	119.6087 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1164.4906
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	102.9805	90.0515	94.2026	80.5868	76.3362	66.9625	65.2979	69.2592	71.4315	81.7398	89.3010	101.6674 (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	102.9805	90.0515	94.2026	80.5868	76.3362	66.9625	65.2979	69.2592	71.4315	81.7398	89.3010	101.6674 (64)
12Total per year (kWh/year)												989.8170 (64)
Electric shower(s)	58.8897	52.4712	57.2965	54.6774	55.7034	53.1356	54.9068	55.7034	54.6774	57.2965	56.2191	58.8897 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												669.8668 (64a)
Heat gains from water heating, kWh/month	40.4675	35.6307	37.8748	33.8161	33.0099	30.0245	30.0512	31.2407	31.5272	34.7591	36.3800	40.1393 (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	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	166.9575	184.8458	166.9575	172.5228	166.9575	172.5228	166.9575	166.9575	172.5228	166.9575	172.5228	166.9575 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.5790	328.9575	320.4438	302.3191	279.4400	257.9369	243.5715	240.1930	248.7067	266.8313	289.7104	311.2136 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064 (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)	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514 (71)
Water heating gains (Table 5)	54.3919	53.0218	50.9070	46.9667	44.3681	41.7008	40.3914	41.9901	43.7878	46.7192	50.5278	53.9506 (72)
Total internal gains	614.0476	633.9444	605.4275	588.9279	557.8850	539.2797	518.0397	516.2599	532.1366	547.6273	579.8803	599.2410 (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						11.8800	10.6334	0.6300	0.7000			0.7700	38.6065 (74)	
East						0.5300	19.6403	0.6300	0.7000			0.7700	3.1812 (76)	
South						15.7500	46.7521	0.6300	0.7000			0.7700	225.0366 (78)	
West						0.5300	19.6403	0.6300	0.7000			0.7700	3.1812 (80)	
Solar gains	270.0055	454.7772	615.3356	761.8708	860.8264	860.0166	826.7372	750.6747	664.9894	500.1107	322.3044	231.8688	(83)	
Total gains	884.0532	1088.7216	1220.7631	1350.7988	1418.7114	1399.2963	1344.7769	1266.9346	1197.1260	1047.7380	902.1847	831.1098	(84)	

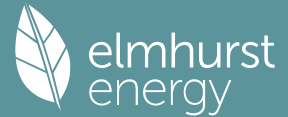
7. Mean internal temperature (heating season)

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	50.7239	50.8461	50.9664	51.5392	51.6478	52.1594	52.1594	52.2552	51.9611	51.6478	51.4285	51.2013
alpha	4.3816	4.3897	4.3978	4.4359	4.4432	4.4773	4.4773	4.4837	4.4641	4.4432	4.4286	4.4134
util living area	0.9968	0.9916	0.9810	0.9492	0.8732	0.7202	0.5549	0.6049	0.8249	0.9638	0.9928	0.9975 (86)
MIT	19.3293	19.5731	19.8946	20.3152	20.6743	20.9057	20.9770	20.9664	20.8173	20.3420	19.7586	19.2929 (87)
Th 2	19.9428	19.9450	19.9472	19.9577	19.9597	19.9688	19.9688	19.9705	19.9653	19.9597	19.9557	19.9516 (88)
util rest of house	0.9958	0.9892	0.9751	0.9326	0.8305	0.6332	0.4351	0.4848	0.7543	0.9486	0.9903	0.9968 (89)
MIT 2	18.4206	18.6647	18.9843	19.4007	19.7314	19.9216	19.9620	19.9596	19.8598	19.4341	18.8583	18.3909 (90)
Living area fraction									fLA = Living area / (4) =			0.1361 (91)
MIT	18.5443	18.7883	19.1082	19.5251	19.8597	20.0555	20.1001	20.0966	19.9901	19.5576	18.9808	18.5137 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5443	18.7883	19.1082	19.5251	19.8597	20.0555	20.1001	20.0966	19.9901	19.5576	18.9808	18.5137 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	878.7258	1072.8114	1182.7876	1248.1137	1171.4772	897.2340	606.5686	633.9963	905.3382	985.8299	890.3627	827.2447 (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	2581.6334	2511.0659	2274.2397	1895.2368	1452.4066	961.5455	616.9081	650.3340	1042.0985	1594.4364	2123.7791	2570.0173 (97)
Space heating kWh	1266.9632	966.5071	812.0404	465.9286	209.0114	0.0000	0.0000	0.0000	0.0000	452.8032	888.0598	1296.6228 (98a)
Space heating requirement - total per year (kWh/year)												6357.9366
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	1266.9632	966.5071	812.0404	465.9286	209.0114	0.0000	0.0000	0.0000	0.0000	452.8032	888.0598	1296.6228 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6357.9366

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Space heating per m2

(98c) / (4) = 41.1011 (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	1656.7704	1304.2661	1337.0593	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7923	0.8697	0.8394	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1312.5985	1134.3176	1122.3690	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1560.9183	1500.4464	1412.8313	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	178.7902	272.3998	216.1039	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	44.6976	68.1000	54.0260	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												166.8235 (107)
Energy for space heating												41.1011 (99)
Energy for space cooling												1.0784 (108)
Total												42.1796 (109)
Fabric Energy Efficiency (DFEE)												42.2 (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	77.9500 (1b)	x 2.3200 (2b)	= 180.8440 (1b) - (3b)
Ground floor	76.7400 (1c)	x 2.8200 (2c)	= 216.4068 (1c) - (3c)
First floor			(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	154.6900		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 397.2508 (5)
Dwelling volume			

2. Ventilation rate

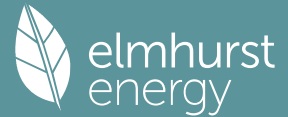
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number 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) = 0.1007 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3507 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3244 (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	0.4136	0.4055	0.3974	0.3568	0.3487	0.3082	0.3082	0.3001	0.3244	0.3487	0.3649	0.3812 (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	0.5855	0.5822	0.5790	0.5637	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5666	0.5726 (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 Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type			28.6900	1.1450	32.8511		(27)
Floor			77.9500	0.1300	10.1335		(28a)
External Wall	219.9600	30.7900	189.1700	0.1800	34.0506		(29a)
Dormer Wall	1.4400		1.4400	0.1800	0.2592		(29a)
Flat	1.2100		1.2100	0.1100	0.1331		(30)
Plane	61.2700		61.2700	0.1100	6.7397		(30)
Sloped	21.8800		21.8800	0.1100	2.4068		(30)
Total net area of external elements Aum(A, m2)			383.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	88.6740		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							213.9474 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	22.1000	0.0500	1.1050
E3 Sill	21.1000	0.0500	1.0550
E4 Jamb	56.1000	0.0500	2.8050
E5 Ground floor (normal)	45.9600	0.1600	7.3536
E6 Intermediate floor within a dwelling	47.0700	0.0000	0.0000
E16 Corner (normal)	46.2000	0.0900	4.1580
E17 Corner (inverted - internal area greater than external area)	23.0200	-0.0900	-2.0718
E11 Eaves (insulation at rafter level)	23.3800	0.0400	0.9352
E12 Gable (insulation at ceiling level)	16.6200	0.0600	0.9972
E13 Gable (insulation at rafter level)	6.7900	0.0800	0.5432
E14 Flat roof	3.2400	0.0800	0.2592
R6 Flat ceiling	28.1800	0.0600	1.6908
E10 Eaves (insulation at ceiling level)	4.8000	0.0600	0.2880
R7 Flat ceiling (inverted)	6.7900	0.0400	0.2716
R5 Ridge (inverted)	4.1600	0.0400	0.1664
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			19.5564 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	108.2304 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	76.7589	76.3235	75.8968	73.8922	73.5172	71.7713	71.7713	71.4480	72.4438	73.5172	74.2759	75.0691 (38)
Average = Sum(39)m / 12 =	184.9894	184.5540	184.1272	182.1227	181.7476	180.0017	180.0017	179.6784	180.6742	181.7476	182.5063	183.2995 (39)
												182.1209
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1959	1.1931	1.1903	1.1773	1.1749	1.1636	1.1636	1.1615	1.1680	1.1749	1.1798	1.1849 (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												2.9413 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	31.7459	31.2744	30.6105	29.3863	28.4697	27.4533	26.9043	27.5635	28.2814	29.3690	30.6184	31.6386 (42c)
Average daily hot water use (litres/day)	44.7517	43.1244	41.4970	39.8697	38.2424	36.6150	36.6150	38.2424	39.8697	41.4970	43.1244	44.7517 (43)
												70.1168 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	76.4976	74.3988	72.1075	69.2560	66.7120	64.0683	63.5193	65.8059	68.1511	70.8660	73.7427	76.3903 (44)
Energy content (annual)	121.1535	105.9429	110.8266	94.8080	89.8072	78.7794	76.8211	81.4815	84.0371	96.1645	105.0600	119.6087 (45)
Distribution loss (46)m = 0.15 x (45)m												1164.4906
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	102.9805	90.0515	94.2026	80.5868	76.3362	66.9625	65.2979	69.2592	71.4315	81.7398	89.3010	101.6674 (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	102.9805	90.0515	94.2026	80.5868	76.3362	66.9625	65.2979	69.2592	71.4315	81.7398	89.3010	101.6674 (64)
12Total per year (kWh/year)												990 (64)
Electric shower(s)	58.8897	52.4712	57.2965	54.6774	55.7034	53.1356	54.9068	55.7034	54.6774	57.2965	56.2191	58.8897 (64a)
Heat gains from water heating, kWh/month	40.4675	35.6307	37.8748	33.8161	33.0099	30.0245	30.0512	31.2407	31.5272	34.7591	36.3800	40.1393 (65)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642	147.0642 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575	166.9575 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	325.5790	328.9575	320.4438	302.3191	279.4400	257.9369	243.5715	240.1930	248.7067	266.8313	289.7104	311.2136 (68)
Pumps, fans	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064	37.7064 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514	-117.6514 (71)
Total internal gains	54.3919	53.0218	50.9070	46.9667	44.3681	41.7008	40.3914	41.9901	43.7878	46.7192	50.5278	53.9506 (72)
	614.0476	633.9444	605.4275	588.9279	557.8850	539.2797	518.0397	516.2599	532.1366	547.6273	579.8803	599.2410 (73)

6. Solar gains												
[Jan]		Area	Solar flux	g	FF	Access	Gains					
		m2	Table 6a	Specific data	Specific data	factor	W					
			W/m2	or Table 6b	or Table 6c	Table 6d						
North		11.8800	10.6334	0.6300	0.7000	0.7700	38.6065 (74)					
East		0.5300	19.6403	0.6300	0.7000	0.7700	3.1812 (76)					
South		15.7500	46.7521	0.6300	0.7000	0.7700	225.0366 (78)					

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West	0.5300		19.6403		0.6300		0.7000		0.7700		3.1812 (80)	
Solar gains	270.0055	454.7772	615.3356	761.8708	860.8264	860.0166	826.7372	750.6747	664.9894	500.1107	322.3044	231.8688 (83)
Total gains	884.0532	1088.7216	1220.7631	1350.7988	1418.7114	1399.2963	1344.7769	1266.9346	1197.1260	1047.7380	902.1847	831.1098 (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	49.6958	49.8131	49.9285	50.4781	50.5822	51.0728	51.0728	51.1647	50.8827	50.5822	50.3720	50.1540
alpha	4.3131	4.3209	4.3286	4.3652	4.3721	4.4049	4.4049	4.4110	4.3922	4.3721	4.3581	4.3436
util living area	0.9968	0.9917	0.9814	0.9507	0.8775	0.7283	0.5640	0.6141	0.8307	0.9647	0.9929	0.9975 (86)
MIT	19.2890	19.5334	19.8583	20.2849	20.6534	20.8963	20.9738	20.9622	20.8034	20.3157	19.7242	19.2524 (87)
Th 2	19.9233	19.9256	19.9278	19.9382	19.9401	19.9492	19.9492	19.9509	19.9457	19.9401	19.9362	19.9321 (88)
util rest of house	0.9958	0.9892	0.9756	0.9344	0.8352	0.6404	0.4410	0.4912	0.7602	0.9498	0.9903	0.9968 (89)
MIT 2	18.3660	18.6107	18.9337	19.3563	19.6968	19.8972	19.9415	19.9386	19.8319	19.3936	18.8096	18.3360 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.4916	18.7362	19.0595	19.4827	19.8269	20.0331	20.0820	20.0779	19.9641	19.5190	18.9340	18.4607 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4916	18.7362	19.0595	19.4827	19.8269	20.0331	20.0820	20.0779	19.9641	19.5190	18.9340	18.4607 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9939	0.9854	0.9693	0.9256	0.8299	0.6482	0.4573	0.5070	0.7617	0.9420	0.9869	0.9953 (94)
Useful gains	878.6740	1072.8528	1183.2354	1250.2351	1177.3506	906.9563	614.9849	642.3828	911.8191	986.9330	890.3747	827.1936 (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	2625.3003	2553.5303	2312.5482	1927.3414	1477.0532	977.9734	626.7679	660.8373	1059.4898	1621.0144	2159.7880	2613.9853 (97)
Space heating kWh	1299.4900	995.0153	840.2087	487.5165	222.9788	0.0000	0.0000	0.0000	0.0000	471.7565	913.9776	1329.3730 (98a)
Space heating requirement - total per year (kWh/year)	6560.3164											
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	1299.4900	995.0153	840.2087	487.5165	222.9788	0.0000	0.0000	0.0000	0.0000	471.7565	913.9776	1329.3730 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	6560.3164											
Space heating per m2	(98c) / (4) = 42.4094 (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	1692.0161	1332.0127	1365.5558	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7807	0.8600	0.8288	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1320.9563	1145.5382	1131.7573	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1560.9183	1500.4464	1412.8313	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	172.7726	264.0517	209.1190	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											
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 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	43.1932	66.0129	52.2798	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	161.4858 (107)											
Energy for space heating	42.4094 (99)											
Energy for space cooling	1.0439 (108)											
Total	43.4534 (109)											
Fabric Energy Efficiency (TFEE)	43.5 (109)											