

Project No: 21029

North Hertfordshire District Council

Energy & Sustainability Statement

Proposed Residential Development on Land Adjacent to 1&2 Millars Close, Picknag
Road, Barley, Hertfordshire

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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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1	27/11/2024	AB	Issued for submission

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 3No. terraced properties on Land Adjacent to 1 & 2 Millars Close, Picknagge Road, Barley, Hertfordshire.

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 **50.49%** 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 dwellings 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 13 of North Hertfordshire District Council's Planning Approval dated 29th July 2024 (23/02948/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 13 of the planning approval dated 29th July 2024 (23/02948/FP) in respect to the proposed construction of 3No. terraced properties on Land Adjacent to 1 & 2 Millars Close, Picknage Road, Barley, Hertfordshire.
- 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 dwellings 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:

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

Planning for climate change

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

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

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

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

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

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

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

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

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

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

- a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

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

- a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas; and
- c) in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of utilising an established site, and approve the proposal if its impacts are or can be made acceptable.

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

2.2 North Hertfordshire District Council

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):*

- i. *create buildings, spaces and streets which positively reflect and respond to the local landscape, townscape and historic character*
 - ii. *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;*
 - iii. *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;*
 - iv. *plan for integrated and mixed-use communities with walkable locally accessible community, employment and retail facilities;*
 - v. *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;*
 - vi. *create an accessible multi-functional green infrastructure network that provides:*
 - *a key structuring and functional place-making feature supporting healthy lifestyles, sport, play and recreation linking into the wider Green Infrastructure Network; and*
 - *a high-quality integrated network to support ecological connectivity, biodiversity net gain, climate adaptation and mitigation linking into the wider Ecological Network*
 - vii. *ensure the effective use of sustainable urban drainage and sustainable water management;*
 - viii. *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*
 - ix. *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:*
- i. *site specific vision and place-making principles*
 - ii. *Masterplan setting out the quantum, scale, type, mix and distribution of land uses, housing and community facilities;*
 - iii. *Green Infrastructure Framework identifying the scale, distribution, type and design of green spaces, biodiversity net gain, strategic drainage and on and off-site linkages:*
 - iv. *Movement Framework setting out the key access points, strategic highways, street hierarchy and footways and cycleways (on and off site)*

- v. *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)*
- vi. *Sustainability & Energy Framework identifying site-wide and building scale opportunities for low and zero carbon*
- vii. *Illustrative Masterplan Layout*
- vii. *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:*
 - i. *create or enhance public realm;*
 - ii. *optimise the potential of the site by incorporating Sustainable Drainage Systems (SuDS);*
 - iii. *reduce energy consumption and waste;*
 - iv. *retain existing vegetation and propose appropriate new planting;*
 - v. *maximise accessibility, legibility and physical and social connectivity both internally and with neighbouring areas;*
 - vi. *future proof for changes in technology and lifestyle;*
 - vii. *design-out opportunities for crime and anti-social behaviour; and*
 - viii. *minimise the visual impact of street furniture and parking provision;*

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

Of further relevance is supporting Paragraph 9.12 which states:

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

2.3 North Hertfordshire District Council's Planning Approval (23/02948/FP)

On the 29th July 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 13 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
New External Wall U-value	0.26 W/m ² K	0.18 W/m²K
New Ground Floor U-value	0.18 W/m ² K	0.11-0.12 W/m²K (plot dependent)
Pitched Roof U-value	0.16 W/m ² K	0.10 W/m²K
Glazing U-value	1.60 W/m ² K	1.20 W/m²K
Entrance Door U-value	1.60 W/m ² K	1.20 W/m²K
Air Permeability	8 m ³ /m ² .h	4.80 m³/m².h
Thermal Bridging	-	Use of Scottish Accredited Construction Details for Timber Frame
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 45 degrees (Mitsubishi Ecodan 5kW PUHZ-W50VHA2-BS)
Hot Water Storage	-	210 litre Hot Water Storage Cylinder with 1.42 kWh / day Standby Loss (Megaflo Eco). Showers to have a maximum flow rate of 8 litres / minute
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 and will not be in keeping with the local area. - The site is sheltered by trees on the northern boundary which would result in unreliable and insufficient outputs. - Require on-going maintenance which future occupants may neglect. - Can produce unacceptable levels of noise to occupants and neighbours.
Conclusion	The technology is not deemed as being suitable for use within the proposed development.

4.3 Solar Photovoltaic

Benefits	- When installed in optimum positions photovoltaic (PV) arrays can generate a large amount of renewable electricity which can be used locally or exported at financial gain to the national grid via the Smart Export Guarantee scheme. - Minimal on-going costs & maintenance issues following installation. - Easy to integrate into a conventional build specification or retro-fit applications. - The dwellings benefit from south west facing pitched roofs to the rear, which would provide a near optimal location to install PV panels to maximise their efficiency and generation capacity.
Site Limitations / Restrictions	- PV panels are not aesthetically pleasing and may detract from the visual appearance of the dwellings. - 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 on-going costs & maintenance issues following installation. - As with PV, the south west facing pitched roof spaces would provide near optimal locations 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. - 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 dwellings 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 Air Source Heat Pumps (Mitsubishi Ecodan 5kW PUHZ-W50VHA2-BS) 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						
Plot	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
A	108.32	13.13	1,422.24	6.40	693.25	51.26%
B	108.32	10.90	1,180.69	5.57	603.34	48.90%
C	108.32	12.99	1,407.08	6.36	688.92	51.04%
Development Total Annual Regulated 'Baseline' CO ₂ Emissions (Kg / Year)						4,010.01
Development Total Annual Regulated Proposed CO ₂ Emissions (Kg / Year)						1,985.51
Development Total Annual Percentage Reduction in CO ₂ Emissions						50.49%

- 5.3 On review of the above, it is evident that the proposed dwelling will achieve a minimum reduction in regulated CO₂ emissions of **50.49%** 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 dwellings 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 13 of North Hertfordshire District Council's Planning Approval dated 29th July 2024 (23/02948/FP) by complying with the requirements of Policies SP9 and D1 of the Local Plan (November 2022).



Appendix 1:

Full SAP 10 Calculations

Full SAP Calculation Printout



Property Reference	21029-A			Issued on Date	27/11/2024
Assessment Reference	Plot A	Prop Type Ref	SAPEST		
Property	Plot A, Picknag Road, Royston				
SAP Rating	71 C	DER	6.40	TER	13.13
Environmental	94 A	% DER < TER			51.26
CO ₂ Emissions (t/year)	0.64	DFEE	49.92	TFEE	50.83
Compliance Check	See BREL	% DFEE < TFEE			1.80
% DPER < TPER	2.36	DPER	67.30	TPER	68.92
Assessor Details	Mr. Samuel Marks			Assessor ID	BP82-0001
Client	21029, Matt Callanan				

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.9568 (5)

2. Ventilation rate

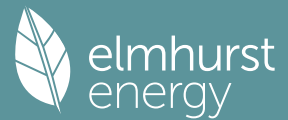
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.1140 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3640 (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) = 0.3367 (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	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)
Effective ac	0.5921	0.5886	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.20)			17.3100	1.1450	19.8206		(27)
Half-Glazed Door			2.9700	1.2000	3.5640		(26a)
NERW			1.6000	1.1450	1.8321		(27a)
SWRW			0.5600	1.1450	0.6412		(27a)
Ground Floor			54.1600	0.1200	6.4992	110.0000	5957.6000 (28a)
External Wall	172.2600	20.2800	151.9800	0.1800	27.3564	9.0000	1367.8200 (29a)
Flat Ceiling	66.5600	2.1600	64.4000	0.1000	6.4400	9.0000	579.6000 (30)
Total net area of external elements Aum(A, m ²)			292.9800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.1535		(33)
Party Wall			55.5300	0.0000	0.0000	110.0000	6108.2999 (32)
TG			73.6000			9.0000	662.4000 (32c)
T1			180.5300			9.0000	1624.7700 (32c)
Internal Floor			54.1600			18.0000	974.8800 (32d)
Internal Ceiling			54.1600			9.0000	487.4400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17762.8098 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							163.9846 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	

Full SAP Calculation Printout



E16 Corner (normal)	9.9000	0.0380	0.3762
E18 Party wall between dwellings	9.9000	0.0860	0.8514
E10 Eaves (insulation at ceiling level)	12.6400	0.0430	0.5435
E12 Gable (insulation at ceiling level)	8.5700	0.0510	0.4371
E2 Other lintels (including other steel lintels)	13.0800	0.0370	0.4840
E3 Sill	11.8000	0.0330	0.3894
E4 Jamb	19.3800	0.0310	0.6008
R1 Head of roof window	2.3700	0.2400	0.5688
R2 Sill of roof window	2.3700	0.2400	0.5688
R3 Jamb of roof window	6.5600	0.2400	1.5744
E6 Intermediate floor within a dwelling	21.2100	0.0650	1.3787
P1 Party wall - Ground floor	8.5700	0.0920	0.7884
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.0900	0.7713
E5 Ground floor (normal)	21.2100	0.0470	0.9969
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.3296 (36)
Point Thermal bridges			0.0000
Total fabric heat loss	(33) + (36) + (36a) =		76.4831 (37)

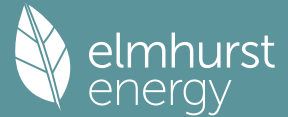
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5783	68.1640	67.7578	65.8502	65.4933	63.8318	63.8318	63.5241	64.4718	65.4933	66.2153	66.9702	(38)
Heat transfer coeff	145.0614	144.6471	144.2409	142.3333	141.9764	140.3149	140.3149	140.0072	140.9549	141.9764	142.6984	143.4532	(39)
Average = Sum(39)m / 12 =												142.3316	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.3392	1.3354	1.3316	1.3140	1.3107	1.2954	1.2954	1.2925	1.3013	1.3107	1.3174	1.3243	(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												2.8044 (42)
Hot water usage for mixer showers	80.1446	78.9402	77.1851	73.8271	71.3490	68.5854	67.0146	68.7563	70.6657	73.6329	77.0631	79.8375 (42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546 (42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494 (42c)
Average daily hot water use (litres/day)												141.8173 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	154.2526	151.0151	147.0404	140.9199	135.9773	130.6526	128.5498	132.5067	136.6879	142.2853	148.5023	153.8416 (44)
Energy content (annual)	244.2985	215.0434	225.9956	192.9123	183.0516	160.6526	155.4698	164.0710	168.5499	193.0798	211.5687	240.8787 (45)
Distribution loss (46)m = 0.15 x (45)m	36.6448	32.2565	33.8993	28.9368	27.4577	24.0979	23.3205	24.6106	25.2825	28.9620	31.7353	36.1318 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119 (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	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119 (64)
12Total per year (kWh/year)												2909.3498 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	118.8558	105.4872	112.7701	100.5561	98.4912	89.8298	89.3203	92.1802	92.4556	101.8256	106.7594	117.7187 (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	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	138.1870	152.9927	138.1870	142.7932	138.1870	142.7932	138.1870	138.1870	142.7932	138.1870	142.7932	138.1870 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713	257.2456 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218 (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)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743 (71)
Water heating gains (Table 5)	159.7524	156.9750	151.5727	139.6613	132.3807	124.7636	120.0541	123.8981	128.4106	136.8623	148.2769	158.2241 (72)
Total internal gains	632.1246	646.9456	619.7002	597.4134	566.6149	545.8298	524.6399	525.6912	541.8473	560.6744	595.6068	618.7220 (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							

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Northeast			5.0600		11.2829		0.6300		0.7000		0.7700		17.4480 (75)
Southwest			8.2300		36.7938		0.6300		0.7000		0.7700		92.5437 (79)
Northwest			4.0200		11.2829		0.6300		0.7000		0.7700		13.8618 (81)
Northeast			1.6000		17.2952		0.6300		0.7000		1.0000		10.9832 (82)
Southwest			0.5600		38.4476		0.6300		0.7000		1.0000		8.5455 (82)

Solar gains	143.3821	260.2787	398.2435	563.2200	693.9489	716.5257	679.3351	577.6916	454.7818	299.0683	174.6730	120.7999	(83)
Total gains	775.5067	907.2243	1017.9436	1160.6334	1260.5638	1262.3555	1203.9750	1103.3828	996.6290	859.7426	770.2799	739.5219	(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	34.0140	34.1114	34.2075	34.6659	34.7531	35.1646	35.1646	35.2419	35.0049	34.7531	34.5772	34.3953	
alpha	3.2676	3.2741	3.2805	3.3111	3.3169	3.3443	3.3443	3.3495	3.3337	3.3169	3.3051	3.2930	
util living area	0.9834	0.9716	0.9493	0.8920	0.7858	0.6263	0.4845	0.5394	0.7598	0.9231	0.9727	0.9857	(86)
Living	19.2901	19.4958	19.8090	20.2343	20.5840	20.8023	20.8744	20.8600	20.6961	20.2379	19.6991	19.2643	
Non living	17.8280	18.0904	18.4862	19.0184	19.4242	19.6559	19.7123	19.7067	19.5604	19.0365	18.3610	17.8035	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.8103	19.8132	19.8161	19.8299	19.8325	19.8445	19.8445	19.8467	19.8398	19.8325	19.8272	19.8218	(88)
util rest of house	0.9796	0.9651	0.9373	0.8658	0.7336	0.5387	0.3689	0.4215	0.6836	0.8986	0.9653	0.9825	(89)
MIT 2	19.8103	19.8132	19.8161	19.8299	19.8325	19.8445	19.8445	19.8467	19.8398	19.8325	19.8272	19.8218	(90)
Living area fraction									fLA = Living area / (4) =			0.3954	(91)
MIT	20.2807	20.2825	20.2842	20.2925	20.2941	20.3014	20.3014	20.3027	20.2986	20.2941	20.2910	20.2877	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2807	20.2825	20.2842	20.2925	20.2941	20.3014	20.3014	20.3027	20.2986	20.2941	20.2910	20.2877	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9812	0.9679	0.9424	0.8770	0.7557	0.5752	0.4162	0.4703	0.7163	0.9093	0.9685	0.9839	(94)
Useful gains	760.9573	878.1129	959.3530	1017.8370	952.5848	726.0594	501.1373	518.9116	713.8805	781.7533	746.0195	727.5851	(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	2318.1807	2225.0309	1988.2523	1621.5385	1220.1595	799.9860	519.3563	546.4075	873.7177	1376.3335	1882.3282	2307.8284	(97)
Space heating kWh	1158.5742	905.1289	765.5011	434.6651	199.0756	0.0000	0.0000	0.0000	0.0000	442.3677	818.1423	1175.7010	(98a)
Space heating requirement - total per year (kWh/year)												5899.1558	
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	1158.5742	905.1289	765.5011	434.6651	199.0756	0.0000	0.0000	0.0000	0.0000	442.3677	818.1423	1175.7010	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5899.1558	
Space heating per m2										(98c) / (4) =		54.4604	(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 %)													321.2016 (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	1158.5742	905.1289	765.5011	434.6651	199.0756	0.0000	0.0000	0.0000	0.0000	442.3677	818.1423	1175.7010	(98)
Space heating efficiency (main heating system 1)	321.2016	321.2016	321.2016	321.2016	321.2016	0.0000	0.0000	0.0000	0.0000	321.2016	321.2016	321.2016	(210)
Space heating fuel (main heating system)	360.7000	281.7946	238.3242	135.3247	61.9784	0.0000	0.0000	0.0000	0.0000	137.7227	254.7130	366.0321	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119	(64)
Efficiency of water heater (217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(216)
Fuel for water heating, kWh/month	258.9615	228.9111	242.6922	211.9363	204.5198	183.2610	180.0027	187.6482	190.2808	213.4337	228.5198	255.9217	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	37.4916	30.0772	27.0811	19.8408	15.3256	12.5212	13.9805	18.1724	23.6042	30.9700	34.9805	38.5336	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

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(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												1836.5897	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												112.5000	
Water heating fuel used												2586.0887	(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)												302.5787	(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												4725.2572	(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	1836.5897	0.1550	284.7326	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2586.0887	0.1410	364.7231	(264)
Space and water heating			649.4557	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	302.5787	0.1443	43.6715	(268)
Total CO2, kg/year			693.1272	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.4000	(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	1836.5897	1.5740	2890.7345	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2586.0887	1.5215	3934.7197	(278)
Space and water heating			6825.4542	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	302.5787	1.5338	464.1054	(282)
Total Primary energy kWh/year			7289.5596	(286)
Dwelling Primary energy Rate (DPER)			67.3000	(287)

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

1. Overall dwelling characteristics

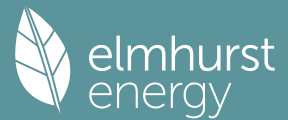
	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)	
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.9568 (5)	

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) =	0.1140 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3640	(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) =	0.3367 (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)

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Adj infilt rate	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)
Effective ac	0.5921	0.5886	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			2.9700	1.0000	2.9700			(26a)
TER Opening Type (Uw = 1.20)			17.3100	1.1450	19.8206			(27)
NERW			1.6000	1.5038	2.4060			(27a)
SWRW			0.5600	1.5038	0.8421			(27a)
Ground Floor			54.1600	0.1300	7.0408			(28a)
External Wall	172.2600	20.2800	151.9800	0.1800	27.3564			(29a)
Flat Ceiling	66.5600	2.1600	64.4000	0.1100	7.0840			(30)
Total net area of external elements Aum(A, m2)			292.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.5199			(33)
Party Wall			55.5300	0.0000	0.0000			(32)

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

163.9846 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	9.9000	0.0900	0.8910
E18 Party wall between dwellings	9.9000	0.0600	0.5940
E10 Eaves (insulation at ceiling level)	12.6400	0.0600	0.7584
E12 Gable (insulation at ceiling level)	8.5700	0.0600	0.5142
E2 Other lintels (including other steel lintels)	13.0800	0.0500	0.6540
E3 Sill	11.8000	0.0500	0.5900
E4 Jamb	19.3800	0.0500	0.9690
R1 Head of roof window	2.3700	0.0800	0.1896
R2 Sill of roof window	2.3700	0.0600	0.1422
R3 Jamb of roof window	6.5600	0.0800	0.5248
E6 Intermediate floor within a dwelling	21.2100	0.0000	0.0000
P1 Party wall - Ground floor	8.5700	0.0800	0.6856
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.1200	1.0284
E5 Ground floor (normal)	21.2100	0.1600	3.3936

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

10.9348 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 78.4547 (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	68.5783	68.1640	67.7578	65.8502	65.4933	63.8318	63.8318	63.5241	64.4718	65.4933	66.2153	66.9702	(38)
Heat transfer coeff	147.0330	146.6187	146.2126	144.3049	143.9480	142.2865	142.2865	141.9788	142.9265	143.9480	144.6700	145.4249	(39)
Average = Sum(39)m / 12 =												144.3032	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3574	1.3536	1.3498	1.3322	1.3289	1.3136	1.3136	1.3107	1.3195	1.3289	1.3356	1.3425	(40)
HLP (average)												1.3322	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

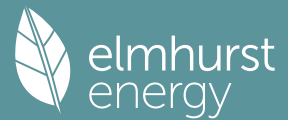
Assumed occupancy													2.8044 (42)
Hot water usage for mixer showers	71.2397	70.1691	68.6090	65.6241	63.4213	60.9648	59.5685	61.1168	62.8139	65.4515	68.5005	70.9667	(42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546	(42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494	(42c)
Average daily hot water use (litres/day)												133.6072	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.3477	142.2439	138.4642	132.7169	128.0496	123.0320	121.1037	124.8671	128.8362	134.1038	139.9397	144.9707	(44)
Energy conte	230.1952	202.5535	212.8144	181.6828	172.3794	151.2822	146.4645	154.6116	158.8679	181.9776	199.3698	226.9891	(45)
Energy content (annual)										Total = Sum(45)m =		2219.1879	
Distribution loss (46)m = 0.15 x (45)m	34.5293	30.3830	31.9222	27.2524	25.8569	22.6923	21.9697	23.1917	23.8302	27.2966	29.9055	34.0484	(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	281.9418	249.2923	264.5610	231.7601	224.1260	201.3595	198.2111	206.3582	208.9452	233.7242	249.4471	278.7357	(62)
WWHRS	-32.5678	-28.8032	-30.1611	-24.9746	-23.2754	-19.9169	-18.6689	-19.8525	-20.6068	-24.2932	-27.5212	-31.9647	(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	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2525.8559	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	117.9372	104.7401	112.1581	100.4714	98.7134	90.3632	90.0967	92.8056	92.8854	101.9048	106.3523	116.8712	(65)

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

Metabolic gains (Table 5), Watts

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	138.1870	152.9927	138.1870	142.7932	138.1870	142.7932	138.1870	138.1870	142.7932	138.1870	142.7932	138.1870	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713	257.2456	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	(71)
Water heating gains (Table 5)	158.5177	155.8633	150.7501	139.5436	132.6793	125.5044	121.0977	124.7387	129.0076	136.9689	147.7116	157.0849	(72)
Total internal gains	633.8899	648.8338	621.8775	600.2957	569.9136	546.5707	525.6835	526.5319	542.4442	563.7809	598.0414	620.5828	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast					5.0600	11.2829	0.6300	0.7000	0.7700	17.4480 (75)			
Southwest					8.2300	36.7938	0.6300	0.7000	0.7700	92.5437 (79)			
Northwest					4.0200	11.2829	0.6300	0.7000	0.7700	13.8618 (81)			
Northeast					1.6000	17.2952	0.6300	0.7000	1.0000	10.9832 (82)			
Southwest					0.5600	38.4476	0.6300	0.7000	1.0000	8.5455 (82)			
Solar gains	143.3821	260.2787	398.2435	563.2200	693.9489	716.5257	679.3351	577.6916	454.7818	299.0683	174.6730	120.7999	(83)
Total gains	777.2720	909.1125	1020.1210	1163.5157	1263.8625	1263.0963	1205.0185	1104.2234	997.2260	862.8492	772.7145	741.3827	(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	33.5579	33.6527	33.7462	34.1923	34.2771	34.6773	34.6773	34.7525	34.5220	34.2771	34.1060	33.9290	
Feb	3.2372	3.2435	3.2497	3.2795	3.2851	3.3118	3.3118	3.3168	3.3015	3.2851	3.2737	3.2619	
util living area	0.9834	0.9717	0.9496	0.8930	0.7882	0.6309	0.4892	0.5442	0.7632	0.9235	0.9727	0.9857	(86)
MIT	18.8146	19.0892	19.5094	20.0808	20.5543	20.8515	20.9522	20.9319	20.7065	20.0889	19.3641	18.7792	(87)
Th 2	19.7961	19.7991	19.8020	19.8157	19.8183	19.8302	19.8302	19.8324	19.8256	19.8183	19.8131	19.8077	(88)
util rest of house	0.9795	0.9652	0.9376	0.8668	0.7358	0.5424	0.3716	0.4245	0.6868	0.8990	0.9652	0.9823	(89)
MIT 2	17.2804	17.6297	18.1599	18.8703	19.4197	19.7313	19.8103	19.8012	19.6023	18.8978	17.9905	17.2424	(90)
Living area fraction													
MIT	17.8870	18.2068	18.6935	19.3490	19.8683	20.1742	20.2618	20.2483	20.0389	19.3688	18.5336	17.8501	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8870	18.2068	18.6935	19.3490	19.8683	20.1742	20.2618	20.2483	20.0389	19.3688	18.5336	17.8501	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9707	0.9533	0.9231	0.8544	0.7382	0.5701	0.4167	0.4694	0.7024	0.8872	0.9541	0.9744	(94)
Ext temp.	754.4972	866.6670	941.6919	994.1033	933.0274	720.1190	502.1153	518.2697	700.4023	765.5400	737.2625	722.4015	(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	1997.7367	1951.0247	1782.8388	1507.8352	1175.8133	793.1324	521.0315	546.3748	848.8265	1262.2492	1654.1020	1985.0617	(97)
Space heating requirement - total per year (kWh/year)	924.9701	728.6884	625.8133	369.8869	180.6327	0.0000	0.0000	0.0000	0.0000	369.5516	660.1244	939.4192	(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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	924.9701	728.6884	625.8133	369.8869	180.6327	0.0000	0.0000	0.0000	0.0000	369.5516	660.1244	939.4192	(98c)
Space heating per m ²										(98c) / (4) =		44.3047	(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)	924.9701	728.6884	625.8133	369.8869	180.6327	0.0000	0.0000	0.0000	0.0000	369.5516	660.1244	939.4192	(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)	1002.1345	789.4782	678.0209	400.7442	195.7017	0.0000	0.0000	0.0000	0.0000	400.3810	715.1944	1017.7890	(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	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710	(64)
Efficiency of water heater													
(217)m	86.7230	86.5330	86.1524	85.3484	83.8226	79.8000	79.8000	79.8000	79.8000	85.3193	86.3497	86.7643	(217)

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Fuel for water heating, kWh/month	287.5522	254.8036	272.0760	242.2842	239.6138	227.3717	224.9901	233.7163	236.0130	245.4673	257.0083	284.4155	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.7125	23.0343	20.7398	15.1949	11.7369	9.5892	10.7068	13.9171	18.0770	23.7180	26.7894	29.5105	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-49.1314	-68.4911	-97.3479	-108.1637	-115.5172	-107.3684	-105.9721	-100.5417	-90.8585	-77.6383	-53.7103	-42.5627	(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	-30.1695	-63.1743	-125.0542	-187.1182	-246.7777	-247.7767	-244.9245	-207.7251	-152.6765	-90.1860	-40.2224	-23.8851	(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												5199.4440	(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												3005.3120	(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)												231.7265	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2676.9937	(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												5845.4888	(238)

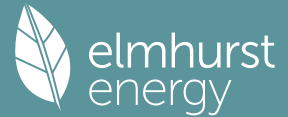
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5199.4440	0.2100	1091.8832	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3005.3120	0.2100	631.1155	(264)
Space and water heating			1722.9988	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	231.7265	0.1443	33.4453	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1017.3034	0.1348	-137.1762	
PV Unit electricity exported	-1659.6903	0.1260	-209.1231	
Total			-346.2993	(269)
Total CO2, kg/year			1422.0740	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.1300	(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	5199.4440	1.1300	5875.3717	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3005.3120	1.1300	3396.0026	(278)
Space and water heating			9271.3742	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	231.7265	1.5338	355.4298	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1017.3034	1.4984	-1524.2981	
PV Unit electricity exported	-1659.6903	0.4625	-767.6328	
Total			-2291.9309	(283)
Total Primary energy kWh/year			7464.9740	(286)
Target Primary Energy Rate (TPER)			68.9200	(287)

Full SAP Calculation Printout



Property Reference	21029-B				Issued on Date	27/11/2024	
Assessment Reference	Plot B			Prop Type Ref	SAPEST		
Property	Plot B, Picknag Road, Royston						
SAP Rating	75 C		DER	5.57		TER	10.90
Environmental	95 A		% DER < TER				48.90
CO ₂ Emissions (t/year)	0.55		DFEE	39.56		TFEE	40.33
Compliance Check	See BREL		% DFEE < TFEE				1.90
% DPER < TPER	-3.08		DPER	58.72		TPER	56.96
Assessor Details	Mr. Samuel Marks					Assessor ID	BP82-0001
Client	21029, Matt Callanan						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.9568 (5)

2. Ventilation rate

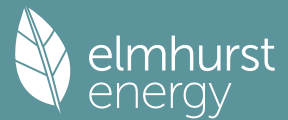
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.1140 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3640 (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) = 0.3367 (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	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)
Effective ac	0.5921	0.5886	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.20)			13.2900	1.1450	15.2176		(27)
Half-Glazed Door			2.9700	1.2000	3.5640		(26a)
NERW			1.6000	1.1450	1.8321		(27a)
SWRW			1.1200	1.1450	1.2824		(27a)
Ground Floor			54.1600	0.1100	5.9576	110.0000	5957.6000 (28a)
External Wall	62.5700	16.2600	46.3100	0.1800	8.3358	9.0000	416.7900 (29a)
Flat Ceiling	66.5600	2.7200	63.8400	0.1000	6.3840	9.0000	574.5600 (30)
Total net area of external elements Aum(A, m ²)			183.2900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.5735		(33)
Party Wall			111.0700	0.0000	0.0000	110.0000	12217.7000 (32)
TG			73.6000			9.0000	662.4000 (32c)
T1			180.5300			9.0000	1624.7700 (32c)
Internal Floor			54.1600			18.0000	974.8800 (32d)
Internal Ceiling			54.1600			9.0000	487.4400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22916.1399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							211.5596 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	

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E18 Party wall between dwellings	19.8000	0.0860	1.7028
E10 Eaves (insulation at ceiling level)	12.6400	0.0430	0.5435
E12 Gable (insulation at ceiling level)	10.5300	0.0510	0.5370
R1 Head of roof window	2.3700	0.2400	0.5688
R2 Sill of roof window	2.3700	0.2400	0.5688
R3 Jamb of roof window	6.5600	0.2400	1.5744
E6 Intermediate floor within a dwelling	12.6400	0.0650	0.8216
E2 Other lintels (including other steel lintels)	10.0200	0.0370	0.3707
E3 Sill	8.7400	0.0330	0.2884
E4 Jamb	15.1400	0.0310	0.4693
E5 Ground floor (normal)	12.6400	0.0470	0.5941
P1 Party wall - Ground floor	17.1400	0.0920	1.5769
P2 Party wall - Intermediate floor within a dwelling	17.1400	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.1400	0.0900	1.5426
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.1590 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	53.7325 (37)

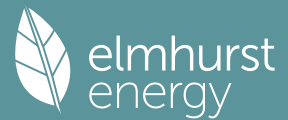
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 68.5783	Feb 68.1640	Mar 67.7578	Apr 65.8502	May 65.4933	Jun 63.8318	Jul 63.8318	Aug 63.5241	Sep 64.4718	Oct 65.4933	Nov 66.2153	Dec 66.9702 (38)
Heat transfer coeff	122.3108	121.8964	121.4903	119.5827	119.2258	117.5643	117.5643	117.2566	118.2042	119.2258	119.9478	120.7026 (39)
Average = Sum(39)m / 12 =												119.5810
HLP	Jan 1.1292	Feb 1.1253	Mar 1.1216	Apr 1.1040	May 1.1007	Jun 1.0853	Jul 1.0853	Aug 1.0825	Sep 1.0913	Oct 1.1007	Nov 1.1073	Dec 1.1143 (40)
HLP (average)												1.1040
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.8044 (42)
Hot water usage for mixer showers	71.2397	70.1691	68.6090	65.6241	63.4213	60.9648	59.5685	61.1168	62.8139	65.4515	68.5005	70.9667 (42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546 (42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494 (42c)
Average daily hot water use (litres/day)												133.6072 (43)
Daily hot water use	Jan 145.3477	Feb 142.2439	Mar 138.4642	Apr 132.7169	May 128.0496	Jun 123.0320	Jul 121.1037	Aug 124.8671	Sep 128.8362	Oct 134.1038	Nov 139.9397	Dec 144.9707 (44)
Energy conte	230.1952	202.5535	212.8144	181.6828	172.3794	151.2822	146.4645	154.6116	158.8679	181.9776	199.3698	226.9891 (45)
Energy content (annual)										Total = Sum(45)m =		2219.1879
Distribution loss (46)m = 0.15 x (45)m	34.5293	30.3830	31.9222	27.2524	25.8569	22.6923	21.9697	23.1917	23.8302	27.2966	29.9055	34.0484 (46)
Water storage loss:												210.0000 (47)
Store volume												1.4200 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7668 (55)
Enter (49) or (54) in (55)												
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	277.2284	245.0351	259.8476	227.1988	219.4126	196.7982	193.4977	201.6448	204.3839	229.0108	244.8858	274.0223 (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	277.2284	245.0351	259.8476	227.1988	219.4126	196.7982	193.4977	201.6448	204.3839	229.0108	244.8858	274.0223 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2772.9659 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Heat gains from water heating, kWh/month	114.1665	101.3343	108.3873	96.8223	94.9427	86.7141	86.3260	89.0349	89.2364	98.1341	102.7033	113.1004 (65)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan 140.2178	Feb 140.2178	Mar 140.2178	Apr 140.2178	May 140.2178	Jun 140.2178	Jul 140.2178	Aug 140.2178	Sep 140.2178	Oct 140.2178	Nov 140.2178	Dec 140.2178 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.9110	158.2229	142.9110	147.6747	142.9110	147.6747	142.9110	142.9110	147.6747	142.9110	147.6747	142.9110 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713	257.2456 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218 (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)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743 (71)
Water heating gains (Table 5)	153.4495	150.7951	145.6819	134.4755	127.6112	120.4363	116.0296	119.6706	123.9394	131.9007	142.6434	152.0167 (72)
Total internal gains	630.5457	645.9958	618.5334	597.1090	566.5695	546.3840	525.3393	526.1877	542.2575	560.4368	594.8548	617.2386 (73)

6. Solar gains												
[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d				Gains W
Northeast			5.0600	11.2829	0.6300	0.7000		0.7700				17.4480 (75)

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Southwest			8.2300		36.7938		0.6300		0.7000		0.7700		92.5437 (79)
Northeast			1.6000		17.2952		0.6300		0.7000		1.0000		10.9832 (82)
Southwest			1.1200		38.4476		0.6300		0.7000		1.0000		17.0910 (82)

Solar gains	138.0658	248.0645	372.4320	514.8267	623.9253	639.8261	608.3940	524.1339	421.4251	283.1841	167.7473	116.6020 (83)
Total gains	768.6116	894.0603	990.9653	1111.9357	1190.4948	1186.2101	1133.7333	1050.3216	963.6826	843.6208	762.6021	733.8407 (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	52.0444	52.2213	52.3959	53.2317	53.3911	54.1457	54.1457	54.2877	53.8525	53.3911	53.0697	52.7378	
alpha	4.4696	4.4814	4.4931	4.5488	4.5594	4.6097	4.6097	4.6192	4.5902	4.5594	4.5380	4.5159	
util living area													
	0.9921	0.9837	0.9656	0.9090	0.7898	0.6035	0.4495	0.5018	0.7466	0.9374	0.9842	0.9935 (86)	
Living	19.8445	20.0112	20.2471	20.5599	20.7883	20.9015	20.9263	20.9224	20.8504	20.5488	20.1504	19.8260	
Non living	18.6288	18.8425	19.1415	19.5337	19.7905	19.9078	19.9243	19.9250	19.8638	19.5308	19.0322	18.6145	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	30	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)	
Th 2	19.9771	19.9802	19.9832	19.9976	20.0003	20.0128	20.0128	20.0151	20.0080	20.0003	19.9948	19.9892 (88)	
util rest of house													
	0.9899	0.9793	0.9559	0.8840	0.7372	0.5219	0.3520	0.3999	0.6702	0.9147	0.9791	0.9917 (89)	
MIT 2	19.9771	19.9802	19.9832	19.9976	20.0003	20.0128	20.0128	20.0151	20.0080	20.0003	19.9948	19.9892 (90)	
Living area fraction													
MIT	20.3816	20.3834	20.3853	20.3939	20.3956	20.4032	20.4032	20.4046	20.4002	20.3956	20.3923	20.3888 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.3816	20.3834	20.3853	20.3939	20.3956	20.4032	20.4032	20.4046	20.4002	20.3956	20.3923	20.3888 (93)	

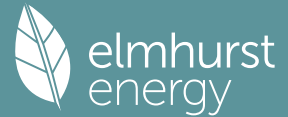
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9908	0.9812	0.9601	0.8947	0.7592	0.5552	0.3911	0.4410	0.7023	0.9246	0.9813	0.9925 (94)	
Useful gains	761.5475	877.2451	951.3827	994.8326	903.8667	658.5416	443.3806	463.1918	676.8089	780.0311	748.3591	728.3157 (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	1966.9471	1887.3749	1686.9258	1374.4765	1036.7359	682.2436	447.1151	469.5612	744.7140	1167.8842	1594.3797	1954.0366 (97)	
Space heating kWh	896.8173	678.8072	547.2441	273.3436	98.8547	0.0000	0.0000	0.0000	0.0000	288.5627	609.1348	911.9363 (98a)	
Space heating requirement - total per year (kWh/year)												4304.7007	
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													
	896.8173	678.8072	547.2441	273.3436	98.8547	0.0000	0.0000	0.0000	0.0000	288.5627	609.1348	911.9363 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												4304.7007	
Space heating per m2												(98c) / (4) =	39.7406 (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 %)													318.6388 (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	896.8173	678.8072	547.2441	273.3436	98.8547	0.0000	0.0000	0.0000	0.0000	288.5627	609.1348	911.9363 (98)	
Space heating efficiency (main heating system 1)	318.6388	318.6388	318.6388	318.6388	318.6388	0.0000	0.0000	0.0000	0.0000	318.6388	318.6388	318.6388 (210)	
Space heating fuel (main heating system)	281.4526	213.0334	171.7443	85.7848	31.0241	0.0000	0.0000	0.0000	0.0000	90.5611	191.1678	286.1975 (211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	277.2284	245.0351	259.8476	227.1988	219.4126	196.7982	193.4977	201.6448	204.3839	229.0108	244.8858	274.0223 (64)	
Efficiency of water heater (217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000 (216)	
Fuel for water heating, kWh/month	246.4252	217.8089	230.9756	201.9545	195.0334	174.9317	171.9979	179.2398	181.6746	203.5652	217.6762	243.5754 (219)	
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)	
Lighting	38.7733	31.1054	28.0069	20.5191	15.8495	12.9492	14.4585	18.7937	24.4111	32.0287	36.1763	39.8509 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)	
Annual totals kWh/year													

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Space heating fuel - main system 1	1350.9655	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	112.5000	
Water heating fuel used	2464.8585	(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)	312.9226	(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	4128.7467	(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	1350.9655	0.1558	210.4342 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2464.8585	0.1410	347.5594 (264)
Space and water heating			557.9937 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	312.9226	0.1443	45.1644 (268)
Total CO2, kg/year			603.1581 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.5700 (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	1350.9655	1.5767	2130.0319 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2464.8585	1.5214	3750.0202 (278)
Space and water heating			5880.0522 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	312.9226	1.5338	479.9711 (282)
Total Primary energy kWh/year			6360.0233 (286)
Dwelling Primary energy Rate (DPER)			58.7200 (287)

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

1. Overall dwelling characteristics

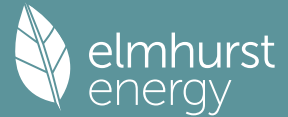
	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	350.9568 (5)

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) = 0.1140 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3640 (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) = 0.3367 (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	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)

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Effective ac 0.5921 0.5886 0.5850 0.5686 0.5655 0.5511 0.5511 0.5485 0.5567 0.5655 0.5717 0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			2.9700	1.0000	2.9700			(26a)
TER Opening Type (Uw = 1.20)			13.2900	1.1450	15.2176			(27)
NERW			1.6000	1.5038	2.4060			(27a)
SWRW			1.1200	1.5038	1.6842			(27a)
Ground Floor			54.1600	0.1300	7.0408			(28a)
External Wall	62.5700	16.2600	46.3100	0.1800	8.3358			(29a)
Flat Ceiling	66.5600	2.7200	63.8400	0.1100	7.0224			(30)
Total net area of external elements Aum(A, m2)			183.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.6768			(33)
Party Wall			111.0700	0.0000	0.0000			(32)

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

211.5596 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E18 Party wall between dwellings	19.8000	0.0600	1.1880
E10 Eaves (insulation at ceiling level)	12.6400	0.0600	0.7584
E12 Gable (insulation at ceiling level)	10.5300	0.0600	0.6318
R1 Head of roof window	2.3700	0.0800	0.1896
R2 Sill of roof window	2.3700	0.0600	0.1422
R3 Jamb of roof window	6.5600	0.0800	0.5248
E6 Intermediate floor within a dwelling	12.6400	0.0000	0.0000
E2 Other lintels (including other steel lintels)	10.0200	0.0500	0.5010
E3 Sill	8.7400	0.0500	0.4370
E4 Jamb	15.1400	0.0500	0.7570
E5 Ground floor (normal)	12.6400	0.1600	2.0224
P1 Party wall - Ground floor	17.1400	0.0800	1.3712
P2 Party wall - Intermediate floor within a dwelling	17.1400	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.1400	0.1200	2.0568

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

10.5802 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 55.2570 (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	68.5783	68.1640	67.7578	65.8502	65.4933	63.8318	63.8318	63.5241	64.4718	65.4933	66.2153	66.9702	(38)
Heat transfer coeff	123.8353	123.4210	123.0148	121.1072	120.7503	119.0888	119.0888	118.7811	119.7288	120.7503	121.4723	122.2271	(39)
Average = Sum(39)m / 12 =												121.1055	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1432	1.1394	1.1357	1.1181	1.1148	1.0994	1.0994	1.0966	1.1053	1.1148	1.1214	1.1284	(40)
HLP (average)												1.1180	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

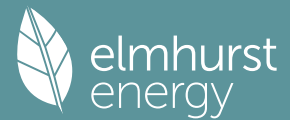
4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8044 (42)
Hot water usage for mixer showers	71.2397	70.1691	68.6090	65.6241	63.4213	60.9648	59.5685	61.1168	62.8139	65.4515	68.5005	70.9667	(42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546	(42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494	(42c)
Average daily hot water use (litres/day)													133.6072 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.3477	142.2439	138.4642	132.7169	128.0496	123.0320	121.1037	124.8671	128.8362	134.1038	139.9397	144.9707	(44)
Energy content (annual)	230.1952	202.5535	212.8144	181.6828	172.3794	151.2822	146.4645	154.6116	158.8679	181.9776	199.3698	226.9891	(45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =			2219.1879
	34.5293	30.3830	31.9222	27.2524	25.8569	22.6923	21.9697	23.1917	23.8302	27.2966	29.9055	34.0484	(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													
	281.9418	249.2923	264.5610	231.7601	224.1260	201.3595	198.2111	206.3582	208.9452	233.7242	249.4471	278.7357	(62)
WWHRS	-32.5678	-28.8032	-30.1611	-24.9746	-23.2754	-19.9169	-18.6689	-19.8525	-20.6068	-24.2932	-27.5212	-31.9647	(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													
	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710	(64)
12Total per year (kWh/year)													
Electric shower(s)													2525.8559 (64)
													2526 (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)
													0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													
Heat gains from water heating, kWh/month													
	117.9372	104.7401	112.1581	100.4714	98.7134	90.3632	90.0967	92.8056	92.8854	101.9048	106.3523	116.8712	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	(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	142.9110	158.2229	142.9110	147.6747	142.9110	147.6747	142.9110	147.6747	142.9110	147.6747	142.9110 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713 (68)
Pumps, fans	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218 (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 (70)
Water heating gains (Table 5)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743 (71)
Total internal gains	158.5177	155.8633	150.7501	139.5436	132.6793	125.5044	121.0977	124.7387	129.0076	136.9689	147.7116 (72)
	638.6139	654.0639	626.6016	605.1772	574.6376	551.4522	530.4075	531.2559	547.3257	568.5049	602.9229 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF Access factor Table 6d	Gains W
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480 (75)
Southwest	8.2300	36.7938	0.6300	0.7000	0.7700	92.5437 (79)
Northeast	1.6000	17.2952	0.6300	0.7000	1.0000	10.9832 (82)
Southwest	1.1200	38.4476	0.6300	0.7000	1.0000	17.0910 (82)
Solar gains	138.0658	248.0645	372.4320	514.8267	623.9253	639.8261 (83)
Total gains	776.6797	902.1285	999.0335	1120.0039	1198.5629	1191.2783 (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	51.4037	51.5763	51.7466	52.5617	52.7170	53.4525	53.4525	53.5910	53.1668	52.7170	52.4037	52.0800
alpha	4.4269	4.4384	4.4498	4.5041	4.5145	4.5635	4.5635	4.5727	4.5445	4.5145	4.4936	4.4720
util living area	0.9918	0.9834	0.9652	0.9090	0.7910	0.6070	0.4528	0.5051	0.7490	0.9368	0.9838	0.9932 (86)
MIT	19.5359	19.7581	20.0740	20.4928	20.8015	20.9556	20.9906	20.9848	20.8856	20.4803	19.9457	19.5102 (87)
Th 2	19.9657	19.9688	19.9718	19.9861	19.9888	20.0013	20.0013	20.0036	19.9965	19.9888	19.9834	19.9777 (88)
util rest of house	0.9895	0.9788	0.9554	0.8839	0.7382	0.5245	0.3536	0.4017	0.6720	0.9138	0.9785	0.9914 (89)
MIT 2	18.2699	18.5536	18.9529	19.4730	19.8197	19.9745	19.9979	19.9976	19.9163	19.4712	18.8042	18.2454 (90)
Living area fraction	fLA = Living area / (4) = 0.3954 (91)											
MIT	18.7705	19.0299	19.3962	19.8762	20.2079	20.3624	20.3904	20.3879	20.2996	19.8702	19.2556	18.7455 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.7705	19.0299	19.3962	19.8762	20.2079	20.3624	20.3904	20.3879	20.2996	19.8702	19.2556	18.7455 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9859	0.9734	0.9486	0.8808	0.7505	0.5554	0.3928	0.4424	0.6970	0.9106	0.9735	0.9882 (94)
Ext temp.	765.6941	878.1054	947.6504	986.4884	899.5352	661.6156	447.3770	466.9177	675.2098	775.5079	750.2613	733.1567 (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	1791.9556	1743.9238	1586.4223	1329.2981	1027.3299	686.2378	451.3931	473.6922	742.2660	1119.3819	1476.5634	1777.8544 (97)
Space heating requirement - total per year (kWh/year)	763.5386	581.8300	475.2463	246.8230	95.0792	0.0000	0.0000	0.0000	0.0000	255.8422	522.9375	777.2551 (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)
Space heating contribution - total per year (kWh/year)	763.5386	581.8300	475.2463	246.8230	95.0792	0.0000	0.0000	0.0000	0.0000	255.8422	522.9375	777.2551 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	3718.5519											34.3293 (99)
Space heating per m2	(98c) / (4) =											

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	763.5386	581.8300	475.2463	246.8230	95.0792	0.0000	0.0000	0.0000	0.0000	255.8422	522.9375	777.2551 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	827.2357	630.3684	514.8930	267.4138	103.0111	0.0000	0.0000	0.0000	0.0000	277.1855	566.5628	842.0966 (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 requirement	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710 (64)
Efficiency of water heater (217)m	86.4010	86.1305	85.6108	84.4577	82.4860	79.8000	79.8000	79.8000	79.8000	84.5098	85.9131	79.8000 (216)
Fuel for water heating, kWh/month	288.6241	255.9943	273.7971	244.8392	243.4966	227.3717	224.9901	233.7163	236.0130	247.8187	258.3144	285.4480 (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	29.6941	23.8217	21.4488	15.7143	12.1382	9.9170	11.0729	14.3929	18.6950	24.5288	27.7052	30.5194	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-49.1647	-68.5475	-97.4333	-108.2571	-115.6092	-107.4500	-106.0634	-100.6469	-90.9656	-77.7224	-53.7557	-42.5913	(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	-30.1362	-63.1179	-124.9688	-187.0248	-246.6857	-247.6951	-244.8332	-207.6199	-152.5694	-90.1019	-40.1770	-23.8565	(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												4028.7670	(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												3020.4236	(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)												239.6482	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2676.9937	(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												4697.8452	(238)

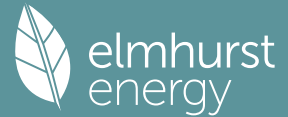
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4028.7670	0.2100	846.0411	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3020.4236	0.2100	634.2890	(264)
Space and water heating			1480.3300	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	239.6482	0.1443	34.5886	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1018.2072	0.1348	-137.2970	
PV Unit electricity exported	-1658.7865	0.1260	-209.0012	
Total			-346.2982	(269)
Total CO2, kg/year			1180.5497	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.9000	(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	4028.7670	1.1300	4552.5067	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3020.4236	1.1300	3413.0787	(278)
Space and water heating			7965.5854	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	239.6482	1.5338	367.5805	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1018.2072	1.4984	-1525.6482	
PV Unit electricity exported	-1658.7865	0.4625	-767.1851	
Total			-2292.8333	(283)
Total Primary energy kWh/year			6170.4334	(286)
Target Primary Energy Rate (TPER)			56.9600	(287)

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Property Reference	21029-C				Issued on Date	27/11/2024	
Assessment Reference	Plot C			Prop Type Ref	SAPEST		
Property	Plot C, Picknag Road, Royston						
SAP Rating	71 C		DER	6.36		TER	12.99
Environmental	94 A		% DER < TER				51.04
CO ₂ Emissions (t/year)	0.63		DFEE	49.13		TFEE	50.11
Compliance Check	See BREL		% DFEE < TFEE				1.96
% DPER < TPER	1.91		DPER	66.89		TPER	68.19
Assessor Details	Mr. Samuel Marks					Assessor ID	BP82-0001
Client	21029, Matt Callanan						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.9568 (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) = 0.1140 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3640 (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) = 0.3367 (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	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)
Effective ac	0.5921	0.5886	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.20)			15.3700	1.1450	17.5992		(27)
Half-Glazed Door			2.9700	1.2000	3.5640		(26a)
NERW			1.6000	1.1450	1.8321		(27a)
SWRW			1.1200	1.1450	1.2824		(27a)
Ground Floor			54.1600	0.1200	6.4992	110.0000	5957.6000 (28a)
External Wall	172.2600	18.3400	153.9200	0.1800	27.7056	9.0000	1385.2800 (29a)
Flat Ceiling	54.1600	2.7200	51.4400	0.1000	5.1440	9.0000	462.9600 (30)
Total net area of external elements A _{um} (A, m ²)			280.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.6265		(33)
Party Wall			55.5300	0.0000	0.0000	110.0000	6108.2999 (32)
TG			73.6000			9.0000	662.4000 (32c)
T1			180.5300			9.0000	1624.7700 (32c)
Internal Floor			54.1600			18.0000	974.8800 (32d)
Internal Ceiling			54.1600			9.0000	487.4400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17663.6298 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							163.0690 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	

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E16 Corner (normal)	9.9000	0.0380	0.3762
E18 Party wall between dwellings	9.9000	0.0860	0.8514
E10 Eaves (insulation at ceiling level)	12.6400	0.0430	0.5435
E12 Gable (insulation at ceiling level)	8.5700	0.0510	0.4371
E2 Other lintels (including other steel lintels)	12.3600	0.0370	0.4573
E3 Sill	11.0800	0.0330	0.3656
E4 Jamb	24.2200	0.0310	0.7508
R1 Head of roof window	2.3700	0.2400	0.5688
R2 Sill of roof window	2.3700	0.2400	0.5688
R3 Jamb of roof window	6.5600	0.2400	1.5744
E6 Intermediate floor within a dwelling	21.2100	0.0650	1.3787
P1 Party wall - Ground floor	8.5700	0.0920	0.7884
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.0900	0.7713
E5 Ground floor (normal)	21.2100	0.0470	0.9969
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.4292 (36)
Point Thermal bridges			0.0000
Total fabric heat loss	(33) + (36) + (36a) =		74.0558 (37)

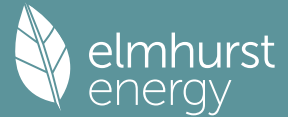
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	68.5783	68.1640	67.7578	65.8502	65.4933	63.8318	63.8318	63.5241	64.4718	65.4933	66.2153	66.9702	(38)
Heat transfer coeff	142.6341	142.2197	141.8136	139.9060	139.5491	137.8876	137.8876	137.5799	138.5275	139.5491	140.2711	141.0259	(39)
Average = Sum(39)m / 12 =												139.9043	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.3168	1.3130	1.3092	1.2916	1.2883	1.2730	1.2730	1.2701	1.2789	1.2883	1.2950	1.3019	(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												2.8044 (42)
Hot water usage for mixer showers	80.1446	78.9402	77.1851	73.8271	71.3490	68.5854	67.0146	68.7563	70.6657	73.6329	77.0631	79.8375 (42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546 (42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494 (42c)
Average daily hot water use (litres/day)												141.8173 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	154.2526	151.0151	147.0404	140.9199	135.9773	130.6526	128.5498	132.5067	136.6879	142.2853	148.5023	153.8416 (44)
Energy content (annual)	244.2985	215.0434	225.9956	192.9123	183.0516	160.6526	155.4698	164.0710	168.5499	193.0798	211.5687	240.8787 (45)
Distribution loss (46)m = 0.15 x (45)m	36.6448	32.2565	33.8993	28.9368	27.4577	24.0979	23.3205	24.6106	25.2825	28.9620	31.7353	36.1318 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7668 (55)
Total storage loss	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (56)
If cylinder contains dedicated solar storage	23.7708	21.4704	23.7708	23.0040	23.7708	23.0040	23.7708	23.7708	23.0040	23.7708	23.0040	23.7708 (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	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119 (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	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119 (64)
12Total per year (kWh/year)												2909.3498 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	118.8558	105.4872	112.7701	100.5561	98.4912	89.8298	89.3203	92.1802	92.4556	101.8256	106.7594	117.7187 (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	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	139.6840	154.6502	139.6840	144.3402	139.6840	144.3402	139.6840	139.6840	144.3402	139.6840	144.3402	139.6840 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713	257.2456 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218 (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)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743 (71)
Water heating gains (Table 5)	159.7524	156.9750	151.5727	139.6613	132.3807	124.7636	120.0541	123.8981	128.4106	136.8623	148.2769	158.2241 (72)
Total internal gains	633.6216	648.6030	621.1972	598.9604	568.1120	547.3768	526.1369	527.1883	543.3942	562.1715	597.1538	620.2191 (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							

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Northeast			5.0600		11.2829		0.6300		0.7000		0.7700		17.4480 (75)
Southwest			6.7200		36.7938		0.6300		0.7000		0.7700		75.5642 (79)
Northwest			3.5900		11.2829		0.6300		0.7000		0.7700		12.3791 (81)
Northeast			1.6000		17.2952		0.6300		0.7000		1.0000		10.9832 (82)
Southwest			1.1200		38.4476		0.6300		0.7000		1.0000		17.0910 (82)

Solar gains	133.4655	244.3402	378.2580	540.3519	669.2251	692.1482	655.7794	555.6430	433.8953	282.0127	162.9860	112.1806 (83)
Total gains	767.0871	892.9433	999.4552	1139.3123	1237.3371	1239.5250	1181.9163	1082.8312	977.2895	844.1842	760.1397	732.3996 (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	34.3997	34.4999	34.5987	35.0704	35.1601	35.5838	35.5838	35.6634	35.4194	35.1601	34.9792	34.7919	
alpha	3.2933	3.3000	3.3066	3.3380	3.3440	3.3723	3.3723	3.3776	3.3613	3.3440	3.3319	3.3195	
util living area	0.9836	0.9722	0.9505	0.8937	0.7878	0.6277	0.4855	0.5407	0.7621	0.9245	0.9731	0.9859 (86)	
Living	19.3077	19.5089	19.8180	20.2410	20.5884	20.8050	20.8760	20.8618	20.6992	20.2443	19.7125	19.2832	
Non living	17.8633	18.1200	18.5111	19.0409	19.4448	19.6753	19.7311	19.7255	19.5796	19.0585	18.3911	17.8405	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)	
Th 2	19.8277	19.8307	19.8336	19.8474	19.8500	19.8621	19.8621	19.8643	19.8574	19.8500	19.8448	19.8393 (88)	
util rest of house	0.9799	0.9659	0.9388	0.8681	0.7364	0.5412	0.3714	0.4243	0.6871	0.9007	0.9659	0.9827 (89)	
MIT 2	19.8277	19.8307	19.8336	19.8474	19.8500	19.8621	19.8621	19.8643	19.8574	19.8500	19.8448	19.8393 (90)	
Living area fraction									fLA = Living area / (4) =			0.3954 (91)	
MIT	20.2912	20.2930	20.2948	20.3032	20.3047	20.3120	20.3120	20.3134	20.3092	20.3047	20.3016	20.2983 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.2912	20.2930	20.2948	20.3032	20.3047	20.3120	20.3120	20.3134	20.3092	20.3047	20.3016	20.2983 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9686	0.9438	0.8790	0.7581	0.5772	0.4181	0.4724	0.7193	0.9110	0.9690	0.9840 (94)	
Useful gains	752.8877	864.9343	943.2843	1001.4574	938.0530	715.4523	494.1248	511.5820	702.9424	769.0924	736.5785	720.7065 (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	2280.8953	2189.1944	1956.2921	1595.3691	1200.7801	787.6153	511.8402	538.4003	860.1451	1354.2841	1851.7963	2270.2711 (97)	
Space heating kWh	1136.8377	889.9028	753.6778	427.6164	195.4690	0.0000	0.0000	0.0000	0.0000	435.3826	802.9568	1152.8761 (98a)	
Space heating requirement - total per year (kWh/year)												5794.7191	
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	1136.8377	889.9028	753.6778	427.6164	195.4690	0.0000	0.0000	0.0000	0.0000	435.3826	802.9568	1152.8761 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												5794.7191	
Space heating per m2										(98c) / (4) =		53.4963 (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 %)													320.9662 (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	1136.8377	889.9028	753.6778	427.6164	195.4690	0.0000	0.0000	0.0000	0.0000	435.3826	802.9568	1152.8761 (98)	
Space heating efficiency (main heating system 1)	320.9662	320.9662	320.9662	320.9662	320.9662	0.0000	0.0000	0.0000	0.0000	320.9662	320.9662	320.9662 (210)	
Space heating fuel (main heating system)	354.1924	277.2575	234.8153	133.2279	60.9002	0.0000	0.0000	0.0000	0.0000	135.6475	250.1687	359.1893 (211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	
Water heating													
Water heating requirement	291.3317	257.5250	273.0288	238.4283	230.0848	206.1686	202.5030	211.1042	214.0659	240.1130	257.0847	287.9119 (64)	
Efficiency of water heater (217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000 (216)	
Fuel for water heating, kWh/month	258.9615	228.9111	242.6922	211.9363	204.5198	183.2610	180.0027	187.6482	190.2808	213.4337	228.5198	255.9217 (219)	
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)	
Lighting	37.8978	30.4030	27.3745	20.0558	15.4916	12.6568	14.1320	18.3693	23.8599	31.3055	35.3595	38.9511 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

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(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												1805.3987	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												112.5000	
Water heating fuel used												2586.0887	(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)												305.8568	(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												4697.3442	(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	1805.3987	0.1550	279.8831	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2586.0887	0.1410	364.7231	(264)
Space and water heating			644.6062	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	305.8568	0.1443	44.1446	(268)
Total CO2, kg/year			688.7508	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.3600	(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	1805.3987	1.5739	2841.5913	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2586.0887	1.5215	3934.7197	(278)
Space and water heating			6776.3109	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	305.8568	1.5338	469.1333	(282)
Total Primary energy kWh/year			7245.4443	(286)
Dwelling Primary energy Rate (DPER)			66.8900	(287)

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

1. Overall dwelling characteristics

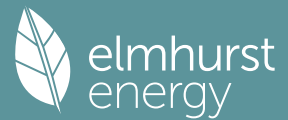
	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	54.1600 (1b)	x 2.5000 (2b)	= 135.4000 (1b) - (3b)	
First floor	54.1600 (1c)	x 3.9800 (2c)	= 215.5568 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	108.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 350.9568 (5)	

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) =	0.1140 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3640	(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) =	0.3367 (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)

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Adj infilt rate	0.4293	0.4208	0.4124	0.3703	0.3619	0.3198	0.3198	0.3114	0.3367	0.3619	0.3788	0.3956 (22b)
Effective ac	0.5921	0.5886	0.5850	0.5686	0.5655	0.5511	0.5511	0.5485	0.5567	0.5655	0.5717	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			2.9700	1.0000	2.9700			(26a)
TER Opening Type (Uw = 1.20)			15.3700	1.1450	17.5992			(27)
NERW			1.6000	1.5038	2.4060			(27a)
SWRW			1.1200	1.5038	1.6842			(27a)
Ground Floor			54.1600	0.1300	7.0408			(28a)
External Wall	172.2600	18.3400	153.9200	0.1800	27.7056			(29a)
Flat Ceiling	54.1600	2.7200	51.4400	0.1100	5.6584			(30)
Total net area of external elements Aum(A, m2)			280.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.0643			(33)
Party Wall			55.5300	0.0000	0.0000			(32)

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

163.0690 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E16 Corner (normal)	9.9000	0.0900	0.8910	
E18 Party wall between dwellings	9.9000	0.0600	0.5940	
E10 Eaves (insulation at ceiling level)	12.6400	0.0600	0.7584	
E12 Gable (insulation at ceiling level)	8.5700	0.0600	0.5142	
E2 Other lintels (including other steel lintels)	12.3600	0.0500	0.6180	
E3 Sill	11.0800	0.0500	0.5540	
E4 Jamb	24.2200	0.0500	1.2110	
R1 Head of roof window	2.3700	0.0800	0.1896	
R2 Sill of roof window	2.3700	0.0600	0.1422	
R3 Jamb of roof window	6.5600	0.0800	0.5248	
E6 Intermediate floor within a dwelling	21.2100	0.0000	0.0000	
P1 Party wall - Ground floor	8.5700	0.0800	0.6856	
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.1200	1.0284	
E5 Ground floor (normal)	21.2100	0.1600	3.3936	

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

11.1048 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 76.1691 (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	68.5783	68.1640	67.7578	65.8502	65.4933	63.8318	63.8318	63.5241	64.4718	65.4933	66.2153	66.9702	(38)
Heat transfer coeff	144.7474	144.3330	143.9269	142.0193	141.6623	140.0009	140.0009	139.6932	140.6408	141.6623	142.3844	143.1392	(39)
Average = Sum(39)m / 12 =												142.0175	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3363	1.3325	1.3287	1.3111	1.3078	1.2925	1.2925	1.2896	1.2984	1.3078	1.3145	1.3214	(40)
HLP (average)												1.3111	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

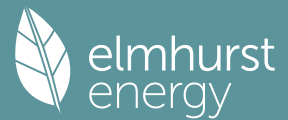
Assumed occupancy													2.8044 (42)
Hot water usage for mixer showers	71.2397	70.1691	68.6090	65.6241	63.4213	60.9648	59.5685	61.1168	62.8139	65.4515	68.5005	70.9667	(42a)
Hot water usage for baths	30.7586	30.3018	29.6585	28.4724	27.5843	26.5995	26.0675	26.7063	27.4018	28.4556	29.6661	30.6546	(42b)
Hot water usage for other uses	43.3494	41.7731	40.1967	38.6204	37.0440	35.4677	35.4677	37.0440	38.6204	40.1967	41.7731	43.3494	(42c)
Average daily hot water use (litres/day)												133.6072	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.3477	142.2439	138.4642	132.7169	128.0496	123.0320	121.1037	124.8671	128.8362	134.1038	139.9397	144.9707	(44)
Energy conte	230.1952	202.5535	212.8144	181.6828	172.3794	151.2822	146.4645	154.6116	158.8679	181.9776	199.3698	226.9891	(45)
Energy content (annual)										Total = Sum(45)m =		2219.1879	
Distribution loss (46)m = 0.15 x (45)m	34.5293	30.3830	31.9222	27.2524	25.8569	22.6923	21.9697	23.1917	23.8302	27.2966	29.9055	34.0484	(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	281.9418	249.2923	264.5610	231.7601	224.1260	201.3595	198.2111	206.3582	208.9452	233.7242	249.4471	278.7357	(62)
WWHRS	-32.5678	-28.8032	-30.1611	-24.9746	-23.2754	-19.9169	-18.6689	-19.8525	-20.6068	-24.2932	-27.5212	-31.9647	(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	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710	(64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2525.8559	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	117.9372	104.7401	112.1581	100.4714	98.7134	90.3632	90.0967	92.8056	92.8854	101.9048	106.3523	116.8712	(65)

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

Metabolic gains (Table 5), Watts

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	140.2178	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	139.6840	154.6502	139.6840	144.3402	139.6840	144.3402	139.6840	139.6840	144.3402	139.6840	144.3402	139.6840	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	269.1198	271.9125	264.8752	249.8935	230.9819	213.2077	201.3334	198.5408	205.5781	220.5597	239.4713	257.2456	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	37.0218	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	-112.1743	(71)
Water heating gains (Table 5)	158.5177	155.8633	150.7501	139.5436	132.6793	125.5044	121.0977	124.7387	129.0076	136.9689	147.7116	157.0849	(72)
Total internal gains	635.3869	650.4912	623.3746	601.8427	571.4107	548.1177	527.1805	528.0289	543.9912	565.2780	599.5884	622.0798	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					5.0600	11.2829	0.6300	0.7000	0.7700		17.4480 (75)	
Southwest					6.7200	36.7938	0.6300	0.7000	0.7700		75.5642 (79)	
Northwest					3.5900	11.2829	0.6300	0.7000	0.7700		12.3791 (81)	
Northeast					1.6000	17.2952	0.6300	0.7000	1.0000		10.9832 (82)	
Southwest					1.1200	38.4476	0.6300	0.7000	1.0000		17.0910 (82)	
Solar gains	133.4655	244.3402	378.2580	540.3519	669.2251	692.1482	655.7794	555.6430	433.8953	282.0127	162.9860	112.1806 (83)
Total gains	768.8524	894.8315	1001.6326	1142.1946	1240.6357	1240.2658	1182.9599	1083.6719	977.8865	847.2907	762.5744	734.2604 (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	33.8974	33.9947	34.0907	34.5486	34.6356	35.0467	35.0467	35.1239	34.8872	34.6356	34.4600	34.2783	
alpha	3.2598	3.2663	3.2727	3.3032	3.3090	3.3364	3.3364	3.3416	3.3258	3.3090	3.2973	3.2852	
util living area	0.9836	0.9723	0.9508	0.8949	0.7904	0.6328	0.4907	0.5460	0.7659	0.9250	0.9731	0.9858	(86)
MIT	18.8343	19.1029	19.5180	20.0866	20.5579	20.8535	20.9531	20.9329	20.7086	20.0947	19.3786	18.8006	(87)
Th 2	19.8125	19.8155	19.8184	19.8321	19.8347	19.8467	19.8467	19.8421	19.8347	19.8347	19.8295	19.8241	(88)
util rest of house	0.9798	0.9660	0.9391	0.8692	0.7388	0.5454	0.3744	0.4276	0.6906	0.9011	0.9658	0.9826	(89)
MIT 2	17.3163	17.6580	18.1822	18.8899	19.4376	19.7484	19.8270	19.8179	19.6189	18.9171	18.0199	17.2805	(90)
Living area fraction									fLA = Living area / (4) =			0.3954	(91)
MIT	17.9165	18.2293	18.7104	19.3631	19.8805	20.1853	20.2723	20.2588	20.0498	19.3827	18.5571	17.8815	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9165	18.2293	18.7104	19.3631	19.8805	20.1853	20.2723	20.2588	20.0498	19.3827	18.5571	17.8815	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9711	0.9544	0.9249	0.8569	0.7411	0.5727	0.4189	0.4720	0.7057	0.8894	0.9549	0.9747	(94)
Useful gains	746.6537	853.9931	926.4080	978.6959	919.4368	710.2468	495.5915	511.4452	690.1401	753.5884	728.1763	715.6966	(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	1970.9550	1923.8604	1757.4052	1485.9639	1158.8743	781.9521	514.1183	539.0430	836.7787	1244.1848	1631.3183	1958.3642	(97)
Space heating kWh	910.8801	718.9508	618.2619	365.2330	178.1415	0.0000	0.0000	0.0000	0.0000	365.0037	650.2622	924.5447	(98a)
Space heating requirement - total per year (kWh/year)												4731.2780	
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	910.8801	718.9508	618.2619	365.2330	178.1415	0.0000	0.0000	0.0000	0.0000	365.0037	650.2622	924.5447	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4731.2780	
Space heating per m ²										(98c) / (4) =		43.6787	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													92.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	910.8801	718.9508	618.2619	365.2330	178.1415	0.0000	0.0000	0.0000	0.0000	365.0037	650.2622	924.5447	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	986.8690	778.9283	669.8396	395.7020	193.0028	0.0000	0.0000	0.0000	0.0000	395.4536	704.5095	1001.6735	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	249.3740	220.4891	234.3999	206.7856	200.8506	181.4426	179.5421	186.5056	188.3384	209.4311	221.9259	246.7710	(64)
Efficiency of water heater	86.6984	86.5101	86.1296	85.3214	83.7918	79.8000	79.8000	79.8000	79.8000	85.2929	86.3228	86.7390	(216)
(217)m													(217)

Full SAP Calculation Printout



Fuel for water heating, kWh/month	287.6339	254.8710	272.1478	242.3608	239.7021	227.3717	224.9901	233.7163	236.0130	245.5435	257.0884	284.4983	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	29.0236	23.2838	20.9645	15.3595	11.8641	9.6931	10.8228	14.0679	18.2728	23.9750	27.0797	29.8302	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-49.1420	-68.5090	-97.3750	-108.1933	-115.5464	-107.3943	-106.0010	-100.5751	-90.8925	-77.6650	-53.7247	-42.5718	(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	-30.1589	-63.1564	-125.0271	-187.0886	-246.7485	-247.7508	-244.8955	-207.6918	-152.6426	-90.1593	-40.2080	-23.8761	(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												5125.9783	(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												3005.9370	(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)												234.2369	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2676.9937	(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												5775.1585	(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	5125.9783	0.2100	1076.4554	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3005.9370	0.2100	631.2468	(264)
Space and water heating			1707.7022	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	234.2369	0.1443	33.8076	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1017.5900	0.1348	-137.2145	
PV Unit electricity exported	-1659.4037	0.1260	-209.0844	
Total			-346.2990	(269)
Total CO2, kg/year			1407.1401	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.9900	(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	5125.9783	1.1300	5792.3555	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3005.9370	1.1300	3396.7088	(278)
Space and water heating			9189.0643	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	234.2369	1.5338	359.2804	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1017.5900	1.4984	-1524.7263	
PV Unit electricity exported	-1659.4037	0.4625	-767.4908	
Total			-2292.2171	(283)
Total Primary energy kWh/year			7386.2284	(286)
Target Primary Energy Rate (TPER)			68.1900	(287)