



EAL CONSULT BUILDING SUSTAINABILITY SINCE 2008

ENERGY & SUSTAINABILITY ASSESSMENT

LAND ADJACENT TO FLINT HOUSE

PROPERTY ADDRESS

**LAND ADJACENT TO FLINT HOUSE
NORTH END
SG8 9SD**

DATE

March 2024

PREPARED BY

EAL Consult

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1.EXECUTIVE SUMMARY

Site description

This Energy and Sustainability Assessment has been prepared to support the planning application for the erection of a detached two storey 5-bedroom dwelling with double garage.

Strategy

The strategy highlights how the proposed development will promote sustainability throughout both design and operation and responds to the UK Planning and regulatory framework, National Planning Policy Framework 2023 and North Herts Council Planning Policy, summarising how the relevant targets will be addressed and achieved.

Energy Hierarchy

In accordance with the Energy Hierarchy, this statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of a 'Fabric First' principle, which will seek to enhance insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document Part L 2021. The viability of district heating will be explored. Further carbon emission reduction will be achieved by using renewable technologies.

- **Be 'Lean':** Passive design principles including a high level of insulation and reduced air permeability to deliver Part L compliant Building in absence of renewable technologies. It will achieve **33.93%** reduction in carbon emissions over Part L 2021 baseline.
- **Be 'Clean':** district heating was deemed not viable for this project
- **Be 'Green':** Air Source Heat Pumps and Solar Photovoltaic Panels have been proposed for the specific scheme and will deliver a further **47.53%** reduction in regulated carbon emissions over Part L 2021 baseline

Energy Efficiency & Carbon Reduction

- This report demonstrates that the proposed development by incorporating the measures above can achieve an **overall** carbon emission reduction of **81.46%**

Overheating

The development proposal will minimise adverse impacts on the urban heat island through design, layout, orientation and materials.

Ventilation

The development utilises natural ventilation in the building.

Sustainable Design:

- Natural lighting is incorporated to prevent excessive demand for artificial lighting
- The development will not increase the air pollution of the area
- Total internal water consumption will not exceed 105 litres/person/day
- All contractors should sign up to the nationally recognised Considerate Constructors Scheme
- Designated space for waste and recycling facilities
- Low Flood Risk area

Reducing Waste and Supporting the Circular Economy:

- Minimising the use of virgin materials during construction by recycling and reusing where feasible.
- Promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
- Encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products
- Low waste benchmark levels will be targeted during construction with requirements identifying that the diversion of waste from landfill is to be achieved by the contractor.

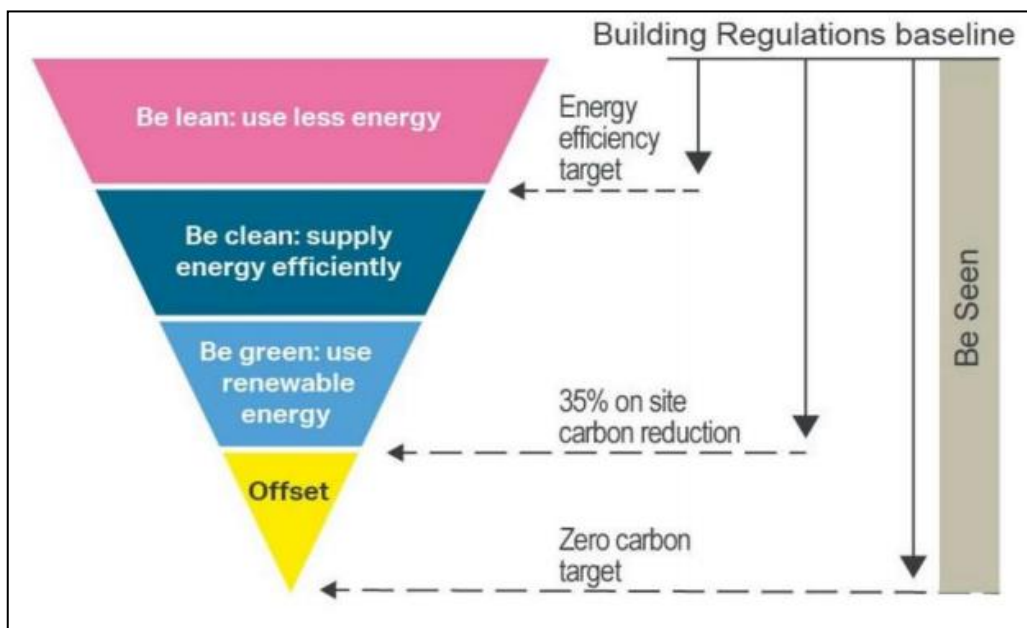
2.METHODOLOGY

This energy assessment outlines the energy demand from the development together with the associated CO₂ emissions, using Building Regulations Part L 2021 as a baseline. It demonstrates how the emissions from energy use in the development will be reduced through energy efficiency measures.

The proposed scheme is required to achieve carbon emission reduction principles in accordance with the UK Planning and regulatory framework.

The methodology employed to determine the potential CO₂ savings is in accordance with the three-step Energy Hierarchy.

Figure 1: The London Plan Energy Hierarchy



- **Be 'Lean'** - Improve the energy efficiency of the scheme;
- **Be 'Clean'** - Supply as much of the remaining energy requirement with low carbon; technologies such as district heating if available or combined heat and power (CHP); and
- **Be 'Green'** - Offset a proportion of the remaining carbon dioxide emissions by using renewable technologies.
- **Be 'Seen'** - monitor, verify and report on post-construction energy performance

The government approved Standard Assessment Procedure (SAP) methodology software (2021) has been used to determine the CO₂ emissions and energy requirements. It compares CO₂ emissions from regulated energy use (DER) with those of an equivalent dwelling built to Part L 2021 (TER), a notional dwelling of the same size and shape.

Opportunities for incorporating features into the development that contribute to the objectives of sustainable development were explored during the design process, to ensure that where possible, the proposals achieve best practice.

3. PLANNING POLICY CONTEXT

National Planning Policy Framework (NPPF) 2023

Emphasised the concept of sustainable development by encouraging local authorities to adopt proactive strategies to mitigate and adapt to climate change. It recommends the move to a low carbon future by:

- Avoiding 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
- Contributing 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.
- To help increase the use and supply of renewable and low carbon energy and heat, plans should:
 - 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);
 - consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
 - identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for colocating potential heat customers and suppliers.
- New updates emphasised that when 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.

North Herts Council Local Plan 2011-2031

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;
- e) For residential schemes, meet or exceed the nationally described space standards and optional water efficiency standards.

Design SPD 2011**9. Sustainability (reducing carbon and increasing efficiency)**

148. Sustainable buildings and sustainable technologies are becoming increasingly more commonplace. Design can play a very big part in the development of more energy efficient buildings and places through the use of emerging and developing technologies and materials. These will enable adaptability to climate change and reduce the use of carbon in both the construction and future maintenance of development. Energy efficiency, renewable resources, water conservation, reducing the need to travel and solar shading are all covered by the sustainability agenda.

149. Various different types of technologies will be employed as the Code For Sustainable home is implemented through the Building Regulations.

150. Sustainable Technologies - such as the use of solar panels and wind turbines should be located to have least visual impact. This may be done through using photovoltaic panels that look like tiles or landscaping to screen or minimise the visual impact of additional features. Some of this development is classified as permitted development, however in conservation areas and on listed buildings advice must be sought as poorly designed and positioned technologies can harm the character of an area.

151. Water efficiency – water should be conserved through the use of water butts / grey water recycling / SUDS / dual flushing toilets, etc. All these type of technologies will contribute to reducing the carbon footprint of the development and minimise consumption of resources.

152. Materials – developments should make the most of any local materials and local construction companies to reduce the carbon footprint of developments. Minimising the distance materials need to travel will contribute to the overall “greenness” of a development.

153. The re-use of materials within a development should also be considered.

154. Sustainable types of materials such as timber and water-based paint could be used as long as it does not detract from the quality of the development and does not negatively impact on the existing character.

155. Recycling space – the need for space for recycling has been iterated in “quality of private space” above. Making allowance for this type of space within all developments, particularly residential, is important as recycling and waste is becoming increasingly more important.

156. If space for recycling bins is not included within developments they are likely to litter the streets and make it look untidy. They can also cause access problems and contribute to street clutter.

157. The need to separate out different waste materials is a issue that is likely to continue in the future, therefore adaptable places that make provision for this will be more pleasant, attractive and less cluttered.

4. ENERGY STRATEGY

The Energy strategy for the proposed development is based on the Building Regulations Part L; it adopts a set of principles to guide design and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. It seeks to incorporate energy efficiency through the approach detailed below.

The following tables and graph demonstrate the average carbon emissions and savings.

Table 1. Carbon Dioxide emissions after each stage of the Energy Hierarchy

	Regulated Carbon dioxide emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	1.75	
After Energy Demand Reduction (Be Lean)	1.15	
After Heat Network Connection (Be Clean)	0	
After Renewables (Be Green)	0.32	

Table 2. Carbon Dioxide Savings from each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
	Tonnes CO ₂ per annum	%
Be Lean: Savings from Energy Demand Reduction	0.59	33.93
Be Clean: Savings from Heat Network	0	0
Be Green: Savings from Renewable Energy	1.27	47.53
Cumulative on-site savings	1.42	81.46
Carbon Shortfall	0.32	

a. Baseline Model

A baseline model is run assuming the development complied with Part L 2021 of the Building Regulations. This baseline model is then used in the Energy Strategy process in comparison to the Be 'Lean', Be 'Clean' and Be 'Green' scenarios of the Energy Hierarchy, to establish the regulated CO₂ emissions from the development.

The baseline model used for this project assumed that any heating and hot water supply would be provided by a heatpump and any active cooling would be provided by electrically powered equipment. The comparative Be 'Lean' model assumes the same heating strategy.

b. Be 'Lean' - Demand Reduction

The building fabric performance and engineering systems have been optimised in order to use less energy prior to the inclusion or consideration of Low and Zero Carbon (LZC) Technology.

Through passive design measures, efficient building fabric and engineering systems the building is estimated to achieve **33.93%** reduction in annual regulated CO₂ emissions over Part L benchmark, therefore demonstrating compliance with Building Regulations Through passive means alone without the utilisation of renewable technologies.

Passive Design Measures

Fabric Performance - The fabric performance values aim to reduce unwanted heat loss and heat gains, whilst maintaining a comfortable internal environment.

The heat loss of different building elements is dependent upon their U –value. A building with low U values provides better levels of insulation and reduced heating demand.

The development will incorporate high levels of insulation and efficient glazing; thereby reduce demand for space heating. The table below shows the U values for the development and the associated improvements over Building Regulations.

Table 3. Energy Efficient Design Specification

Element	Building Regulations 2021 Standard	Specification
Wall	0.18 W/m ² k	0.14 W/m ² k
Roof	0.11 W/m ² k	0.11 W/m ² k
Floor	0.13 W/m ² k	0.10 W/m ² k
Glazing	1.2 W/m ² k	1.2 W/m ² k

Thermal Bridging - Thermal bridging will be reduced. The thermal bridging calculations achieve an average γ -value of 0.059 aligning with enhanced construction detail and cold bridges will be avoided.

Air Permeability – designed to achieve an air permeability score of 3

Efficient Lighting and Controls - Throughout the development natural lighting will be optimised. The development will also incorporate low energy light fittings throughout. All light fittings will be specified as low energy lighting and will accommodate LED luminaries only.

Ventilation - The use of natural ventilation is proposed for the dwelling.

Space Heating & Cooling - Space heating will be provided by underfloor heating by the ASHP.

Domestic Hot Water (DHW) system – domestic hot water is supplied for the dwelling via the built in cylinder.

Waste Water Heat Recovery – A Zyphe iZi 40 System A instantaneous system will be used

c. Be 'Clean' - Supply Energy Efficiently

The Be Clean step of the energy hierarchy refers to the use of 'Clean energy supply'. This includes, but is not limited to, the use of Combined Heat and Power (CHP) and District Heat Networks.

District Heating and Cooling

There is no existing or planned heat and energy network in the vicinity and the site does not fall into an opportunity area with decentralised energy potential.

Community heating and Combined Heat and Power (CHP system)

CHP systems are usually needed where there is a large heat demand (schemes with more than 100-150 dwellings), usually resulting from the building(s) being in continuous use, or through specific heating requirements such as a swimming pool. Community (or district) heating involves using a central boiler plant (or other heat sources) to heat a number of buildings through a network of well-insulated underground pipes. This system is not considered appropriate for this development

In light of the small scale of the proposed development, it is apparent that the use of CHP is also technically and financially unviable in this instance.

Site-wide communal system/network and design for district network connection

In light of the small scale of the proposed development and its location; it is apparent that the use of a heatpump fed site-wide network is technically and financially unviable.

d. Be 'Green' - Renewable Energy

Once energy demand reduction measures have been applied, methods for generating low and zero carbon energy can be assessed. The following renewable technologies can be considered for the project: Biomass, Water source heat pump, air source heat pump, Wind energy and solar photovoltaic panels.

Table 4. Renewable Technologies Feasibility Table

Technology	Pros	Cons
Biomass Heating A biomass system designed for wood pellets, which have a high-energy content, would fuel this development. 	• Less volume of storage • Less maintenance and produce considerably less ash residue	• Nox Emissions which may impact • High Costs • Not suitable for the project

Ground Source Heat Pump It circulates a mixture of water and antifreeze around a loop of pipe, called a ground loop, which is buried in the garden. Heat from the ground is absorbed into the fluid and passes through a heat exchanger into the heat pump 	• Use all through the year	• High Costs • Not suitable for this project
Air Source Heat Pump They are an efficient and environmentally-friendly way of heating using air drawn freely from the atmosphere. They operate rather like a refrigerator in reverse, absorbing heat from the air into a working fluid which is passed into a compressor where its temperature is increased before it is transferred into the heating and hot water circuits of the building	• Can generate less CO₂ than conventional heating systems. • Cheaper • Provides heating and hot water • Less maintenance • Can be used as air-conditioning in the summer	• Needs electricity • Can be noisy
Wind Turbines Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings. 	• Cheaper • Less CO₂	• Local wind speeds in the area is likely to be below the level generally required for investment in large wind turbines. • Noise and signal interference. • Detrimental aesthetic impact
Solar Photovoltaic Panels (PV) Photovoltaic panels extract the energy of the sun to generate electricity. They operate most efficiently when oriented to the south and are inclined to about 35 degrees. 	• Cheaper • Less CO₂ • No input power in order to generate electricity.	

Renewable Technologies Feasibility Review Conclusion

The renewable energy sources that have been reviewed for this project are Biomass Heating, Ground Source Heat Pump, Air Source Heat Pump, Domestic Wind Turbine and Solar Photovoltaic Panels (PV).

On review of the above technologies, it has been concluded that the use of an air source heat pump and PV panels are to be incorporated in the design because it achieves a CO₂ percentage reduction of **47.53%** contributing to an overall reduction of **81.46%** in carbon emissions.

Table 5. Photovoltaic Panels

System size	Orientation	Degree	Panels
1.5 kWp	North	30	4.5 (approx)
1.5 kWp	South	30	4.5 (approx)

e. Be ‘Seen’ - Monitoring Performance

Achieving an EPC rating of A98, the operational running costs will be low due to the high performance. As the development includes renewable technologies it is less reliant on the main grid and will protect the consumer from high prices.

Smart metering equipment will be installed with display of energy usage and generation to raise awareness of occupants. This can help occupants to reduce demand and subsequent running costs. An on-site operational manual will be provided for the occupants on completion of the build to assist residents better understanding of appliances and cost management.

5.SUSTAINABILITY STRATEGY

a. Sustainable Design

The proposed project incorporates sustainable design and construction measures capable of mitigating and adapting to climate change to meet future needs. This section details site-specific initiatives which demonstrate how the conversion helps to meet the sustainability objectives set out in the National Planning Framework 2023.

Materials Efficiency

Materials can have a significant impact on environmental performance, both in construction but also ongoing use. Materials used for the building will have lower environmental impacts over their lifecycle. This applies to the materials used in the external walls, roof and glazing. This extends to elements of the materials category such as the basic building materials (internal walls) and the finishing elements (fascia, skirting, and furniture).

b. Overheating Strategy

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

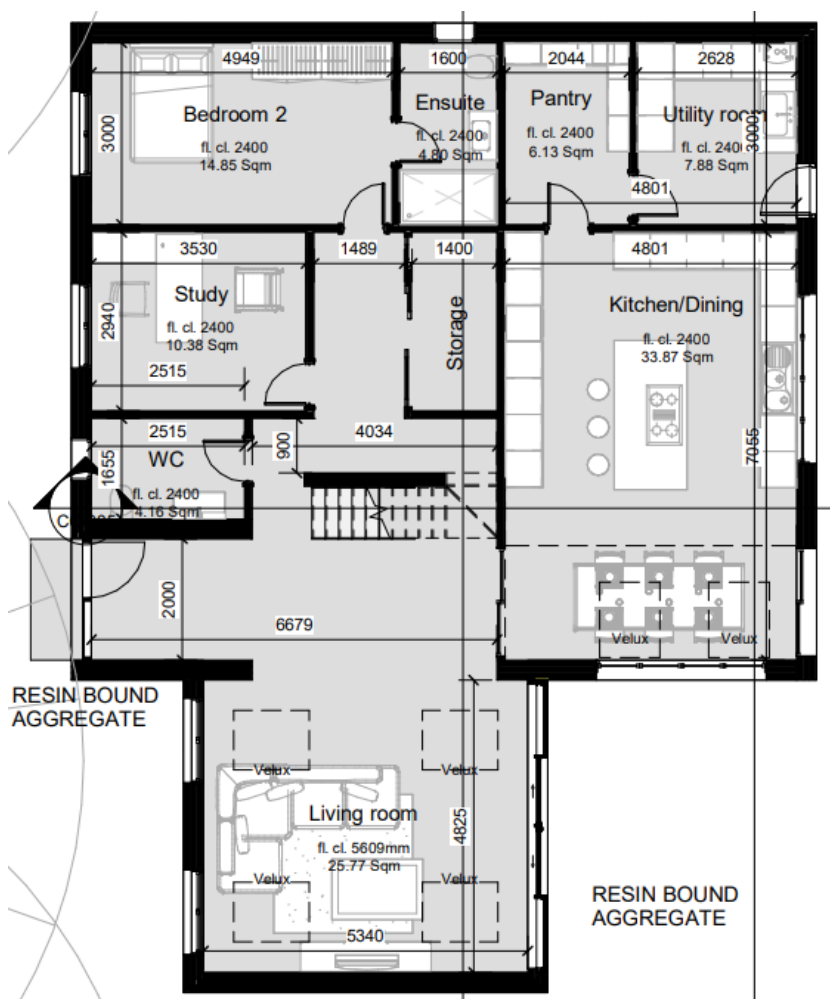
Minimise Heat Generation Through Energy Efficient Design

Through the use of passive and active design measures, the design team have enabled the development to require less energy through the use of optimised insulation, cross ventilation, improved window u-values, higher air tightness and reduced cold bridging.

Daylight

The design of the development has taken into consideration day lighting to habitable spaces to improve the wellbeing of occupants. Good levels of daylight will offer occupants a pleasant and highly valued connection to the outdoors and plenty of natural light. It will also reduce the use of artificial lighting and therefore energy use. All light fittings will be specified as low energy lighting. No external lighting is required. The location and orientation of windows help to create a design that avoids overheating in the summer.

Figure 2. Internal layout



c. Water Efficiency

Water: Water Efficiency

In domestic and non-domestic buildings, the demand for water can be reduced as much as 50% using a variety of simple and innovative strategies that are integrated into the plumbing and mechanical systems. In order to reduce water consumption the proposed development will include efficient fixtures with low flow rates. Total internal water consumption will not exceed 105 litres/person/day.

Table 6. Water Fittings Standards

Schedule Appliance Water Consumption		
Appliance	Flow rate or Capacity	Total Litres
WC	Dual flush WC 4/2.6 litre	14.72
Basin	1.7 litres/min	5.98
Shower	8 litres/minute flow	24.00
Bath	160 litres	25.60
Sink	4 litres/min	14.13
W/machine	Default used	16.66
Dish Washer	Default used	3.90
		104.99

d. Pollution: Light, Air and Noise

Light

Light pollution can best be described as artificial light that is allowed to illuminate or intrude upon areas not intended to be lit. Light in the wrong place at the wrong time can be intrusive.

Intrusive light is over bright or poorly directed lights shining onto neighbouring property which affect the neighbours' right to enjoy their property. Therefore, the proposal will incorporate lighting measures in order to avoid causing a nuisance.

Air and Noise

The layout of the development can provide good internal air quality for habitable areas but not too much so as to waste heat.

The use of openable windows will create horizontal airflow. By achieving a good naturally ventilated building the energy demand for air conditioning and mechanical ventilation will thereby be eliminated within the development.

The development will not increase the air pollution of the area by reducing as a start, its energy use, which in turn will reduce emissions that lead to air pollution.

Other measures will include:

- Use of eco-friendly building materials
- Non-toxic paints
- Installation of energy efficient appliances and devices
- Use of renewable technologies

e. Waste Management

Considerate Construction

All contractors would be required to sign up to the nationally recognised Considerate Constructors Scheme which requires, amongst other things that dust emissions, potential noise pollution, impacts on water quality and the potential for ground contamination are minimised during demolition and construction. The Contractor would also be obliged to adhere to a site-specific Code of Construction Practice to reduce potential nuisance effects.

Diversion of waste from landfill

- Where possible, segregation of recyclable and non-recyclable material will be employed for all waste generated throughout the construction process. Furthermore, material will be re-used on-site where feasible;
- Pre-fabrication of materials/elements such as bathroom pods, pipework and riser materials will be considered;
- Reusable packing solutions with key product manufacturers will be explored at the earliest opportunity. Solutions may include flat pallets, bulk bags, steel stillages and returnable cable drums;
- Construction waste – minimum 80% diversion from landfill rate;
- Demolition waste – minimum 90% diversion from landfill rate;

Operational Waste

Target diversion from landfill rate to be set.

A space for reuse and recycling has been included at the ground floor unit for the residents exclusive use.

f. Flood Risk

The development site is located in a Low Flood Risk Area on the Environment Agency Flood Risk Map.

g. Sustainable Procurement

It is expected that all timber used in the development will come from a legal Source (FSC Scheme). At least 80% of the building materials will be responsibly sourced and will use suppliers who can provide an EMS certificate or equivalent. Materials rated with an A or B in the BRE Green Guide to Specification will be preferred.

Other measures will be implemented:

- The reuse of existing materials from the demolition of existing buildings
- At least 20% of the total value of materials used should derive from recycled and reused content in the products and materials selected;
- Steel will have a high recycled content;
- Concrete will have a Ground Granulated Blast Furnace Slag (GGBS) value of 50%.

h. Biodiversity and Green Infrastructure

The proposed development aims to retain a large amount of the existing biodiversity on site, particularly species rich grassland and existing trees. Some area surrounding the house will be amenity grassland with additional trees and bushes being planted. Care will also be taken to use permeable paving where possible and planting of some flower-rich perennial planting.

6. CONCLUSION

The development has been designed to exceed Part L building regulations requirements. In line with the national and local policies, regulated CO₂ emissions from the development will be reduced by **81.46%** from the notional emissions once energy efficiency measures and lean measures are taken into account.

The use of air source heat pumps and photovoltaic panels are to be incorporated in the design because they achieve a CO₂ percentage reduction of **47.53%** contributing to the overall reduction of **81.46%** in carbon emissions. The remainder is made up from a fabric first approach with U-values outlined in the specification column of Table 3 on Page 8 of this report.

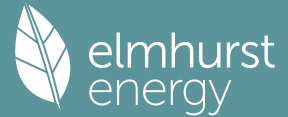
An appraisal of the proposed development has been undertaken against key sustainability objectives identified from relevant policy guidance. The framework for the appraisal was guided by the National Plan. This process has ensured that the development responds to the sustainable development objectives that are relevant to the area. Key sustainability initiatives in ecology, waste management, water, health and wellbeing, materials, pollution and Surface water management have been incorporated in the design of the proposed Development.

7. APPENDIX

A. SAP Calculations

i. Baseline

Full SAP Calculation Printout



Property Reference	Flint House				Issued on Date	14/03/2024
Assessment Reference	Option 1	Prop Type Ref		Flint House		
Property	Land Adj to, Flint House, ROYSTON, SG8 9SD					
SAP Rating	62 D	DER	7.28	TER	7.48	
Environmental	92 A	% DER < TER				2.67
CO ₂ Emissions (t/year)	1.62	DFEE	55.01	TFEE	43.01	
Compliance Check	See BREL	% DFEE < TFEE				-27.90
% DPER < TPER	-87.48	DPER	75.12	TPER	40.07	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	146.0700 (1b)	x 2.3700 (2b)	= 346.1859 (1b) - (3b)
First floor	93.9200 (1c)	x 2.9400 (2c)	= 276.1248 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 622.3107 (5)

2. Ventilation rate

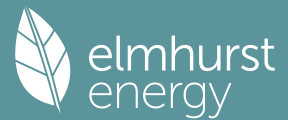
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.0643 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3143 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3143 (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	0.4007	0.3928	0.3850	0.3457	0.3378	0.2986	0.2986	0.2907	0.3143	0.3378	0.3536	0.3693 (22b)
Effective ac	0.5803	0.5772	0.5741	0.5598	0.5571	0.5446	0.5446	0.5423	0.5494	0.5571	0.5625	0.5682 (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
Windows (Uw = 1.60)			52.8900	1.5038	79.5338		(27)
Rooflights			2.4400	1.5038	3.6692		(27a)
Rooflights			2.4400	1.5038	3.6692		(27a)
Rooflights			2.4400	1.5038	3.6692		(27a)
Underground			146.0700	0.2200	32.1354	110.0000	16067.7000 (28a)
External Wall	226.3500	52.8900	173.4600	0.2800	48.5688	70.0000	12142.2000 (29a)
Rafter	150.4500	7.3200	143.1300	0.1600	22.9008	9.0000	1288.1700 (30)
Total net area of external elements Aum(A, m ²)			522.8700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	194.1464			(33)
FF			93.9200			18.0000	1690.5600 (32d)
GF			93.9200			9.0000	845.2800 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	32033.9100			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K				133.4802			(35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				30.9100	0.3000	9.2730	
E3 Sill				19.6000	0.0400	0.7840	
E4 Jamb				56.7000	0.0500	2.8350	

Full SAP Calculation Printout



E5 Ground floor (normal)	53.9500	0.1600	8.6320
E6 Intermediate floor within a dwelling	27.6600	0.0600	1.6596
E11 Eaves (insulation at rafter level)	10.3200	0.0400	0.4128
E12 Gable (insulation at ceiling level)	11.6300	0.2400	2.7912
E13 Gable (insulation at rafter level)	26.3000	0.0400	1.0520
E16 Corner (normal)	14.2200	0.0900	1.2798
E17 Corner (inverted - internal area greater than external area)	4.7400	-0.0900	-0.4266
E16 Corner (normal)	5.8800	0.0900	0.5292
R1 Head of roof window	6.9400	0.0800	0.5552
R2 Sill of roof window	7.3400	0.0600	0.4404
R3 Jamb of roof window	12.8000	0.0800	1.0240
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			30.8416 (36)
Point Thermal Bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	224.9880 (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	119.1680	118.5278	117.9003	114.9528	114.4014	111.8342	111.8342	111.3588	112.8231	114.4014	115.5170	116.6833	(38)
Heat transfer coeff	344.1560	343.5158	342.8883	339.9408	339.3893	336.8222	336.8222	336.3468	337.8110	339.3893	340.5049	341.6712	(39)
Average = Sum(39)m / 12 =												339.9382	
HLP	1.4340	1.4314	1.4288	1.4165	1.4142	1.4035	1.4035	1.4015	1.4076	1.4142	1.4188	1.4237	(40)
HLP (average)												1.4165	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0539 (42)
Hot water usage for mixer showers	75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350	(42a)
Hot water usage for baths	34.2716	33.7626	33.0459	31.7243	30.7347	29.6375	29.0448	29.7565	30.5315	31.7056	33.0544	34.1557	(42b)
Hot water usage for other uses	48.3212	46.5641	44.8070	43.0498	41.2927	39.5355	39.5355	41.2927	43.0498	44.8070	46.5641	48.3212	(42c)
Average daily hot water use (litres/day)												145.2420	(43)
Daily hot water use	158.0168	154.6173	150.4917	144.2527	139.1739	133.7187	131.6477	135.7557	140.0847	145.8084	152.1424	157.6120	(44)
Energy conte	250.2601	220.1729	231.3001	197.4748	187.3548	164.4227	159.2164	168.0939	172.7384	197.8607	216.7548	246.7823	(45)
Energy content (annual)										Total = Sum(45)m =		2412.4319	
Distribution loss (46)m = 0.15 x (45)m	37.5390	33.0259	34.6950	29.6212	28.1032	24.6634	23.8825	25.2141	25.9108	29.6791	32.5132	37.0173	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												0.8400	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.4536	(55)
Total storage loss	14.0616	12.7008	14.0616	13.6080	14.0616	13.6080	14.0616	14.0616	13.6080	14.0616	13.6080	14.0616	(56)
If cylinder contains dedicated solar storage	14.0616	12.7008	14.0616	13.6080	14.0616	13.6080	14.0616	14.0616	13.6080	14.0616	13.6080	14.0616	(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	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063	(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	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2851.8919	(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	113.0707	100.1771	106.7665	94.5564	92.1547	83.5665	82.7987	85.7504	86.3315	95.6479	100.9670	111.9143	(65)

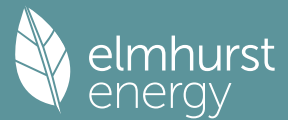
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	(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)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	(71)
Water heating gains (Table 5)	151.9767	149.0731	143.5033	131.3283	123.8638	116.0646	111.2885	115.2560	119.9049	128.5590	140.2319	150.4225	(72)
Total internal gains	834.0096	857.3644	819.1070	791.0933	748.1308	720.2631	690.6482	690.3858	712.5472	737.0399	784.2108	814.4699	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3300	10.6334	0.6300	0.7000	0.7700	4.3221	(74)
East	28.6100	19.6403	0.6300	0.7000	0.7700	171.7264	(76)
South	3.3800	46.7521	0.6300	0.7000	0.7700	48.2936	(78)
West	19.5700	19.6403	0.6300	0.7000	0.7700	117.4654	(80)

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East			2.4400	26.6072	0.6300	0.7000	1.0000	25.7674 (82)
South			2.4400	42.0754	0.6300	0.7000	1.0000	40.7473 (82)
West			2.4400	26.6072	0.6300	0.7000	1.0000	25.7674 (82)

Solar gains	434.0895	832.5418	1342.2752	1931.4486	2356.0107	2409.7461	2294.8286	1976.4990	1550.9189	979.1820	537.9700	359.2429 (83)
Total gains	1268.0992	1689.9062	2161.3822	2722.5419	3104.1415	3130.0093	2985.4768	2666.8848	2263.4661	1716.2220	1322.1808	1173.7128 (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	25.8555	25.9036	25.9510	26.1761	26.2186	26.4184	26.4184	26.4558	26.3411	26.2186	26.1327	26.0435
alpha	2.7237	2.7269	2.7301	2.7451	2.7479	2.7612	2.7612	2.7637	2.7561	2.7479	2.7422	2.7362
util living area												
	0.9872	0.9723	0.9391	0.8616	0.7393	0.5872	0.4575	0.5181	0.7444	0.9241	0.9780	0.9896 (86)
Living	18.6834	18.9803	19.4433	20.0176	20.4638	20.7319	20.8315	20.8072	20.5699	19.9304	19.1948	18.6370
Non living	17.0360	17.4142	17.9982	18.7086	19.2256	19.5097	19.5925	19.5797	19.3634	18.6235	17.6970	16.9819
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	31	28	31	30	0	0	0	0	0	7	30	31
16 / 9	0	0	0	0	0	0	0	0	0	23	0	0
MIT	21.0000	21.0000	21.0000	21.0000	20.4638	20.7319	20.8315	20.8072	20.5699	20.5160	21.0000	21.0000 (87)
Th 2	19.7373	19.7394	19.7414	19.7507	19.7525	19.7607	19.7607	19.7622	19.7575	19.7525	19.7489	19.7452 (88)
util rest of house												
	0.9845	0.9665	0.9263	0.8325	0.6849	0.5007	0.3430	0.4003	0.6691	0.9017	0.9725	0.9874 (89)
MIT 2	19.7373	19.7394	19.7414	19.7507	19.2256	19.5097	19.5925	19.5797	19.3634	19.3464	19.7489	19.7452 (90)
Living area fraction									FLA = Living area / (4) =			0.2226 (91)
MIT	20.0184	20.0200	20.0215	20.0288	19.5012	19.7818	19.8683	19.8529	19.6320	19.6067	20.0274	20.0245 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0184	20.0200	20.0215	20.0288	19.5012	19.7818	19.8683	19.8529	19.6320	19.6067	20.0274	20.0245 (93)

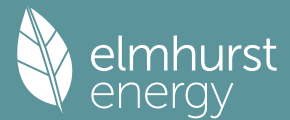
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9852	0.9679	0.9295	0.8396	0.6725	0.5023	0.3536	0.4096	0.6602	0.8986	0.9739	0.9880 (94)
Useful gains	1249.3427	1635.7233	2008.8999	2285.7874	2087.6318	1572.1889	1055.5641	1092.4656	1494.2454	1542.1448	1287.6151	1159.6015 (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												
	5409.5785	5193.9484	4636.3699	3783.1339	2647.6534	1745.3388	1100.8363	1161.3792	1868.7604	3056.7846	4401.8458	5406.7846 (97)
Space heating kWh												
	3095.2154	2391.1272	1954.8376	1078.0895	416.6561	0.0000	0.0000	0.0000	0.0000	1126.8920	2242.2461	3159.9043 (98a)
Space heating requirement - total per year (kWh/year)												15464.9682
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												
	3095.2154	2391.1272	1954.8376	1078.0895	416.6561	0.0000	0.0000	0.0000	0.0000	1126.8920	2242.2461	3159.9043 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15464.9682
Space heating per m2										(98c) / (4) =		64.4401 (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 %)												192.5078 (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												
	3095.2154	2391.1272	1954.8376	1078.0895	416.6561	0.0000	0.0000	0.0000	0.0000	1126.8920	2242.2461	3159.9043 (98)
Space heating efficiency (main heating system 1)												
	192.5078	192.5078	192.5078	192.5078	192.5078	0.0000	0.0000	0.0000	0.0000	192.5078	192.5078	192.5078 (210)
Space heating fuel (main heating system)												
	1607.8392	1242.0939	1015.4591	560.0239	216.4360	0.0000	0.0000	0.0000	0.0000	585.3748	1164.7562	1641.4425 (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												
	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (64)
Efficiency of water heater (217)m												
	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
Fuel for water heating, kWh/month												
	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (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	83.6272	67.0888	60.4061	44.2561	34.1847	27.9292	31.1844	40.5347	52.6505	69.0803	78.0261	85.9515 (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	8033.4255	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	100.0000	
Water heating fuel used	2851.8919	(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)	674.9194	(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	11560.2368	(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	8033.4255	0.1553	1247.8753	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2851.8919	0.1411	402.5061	(264)
Space and water heating			1650.3814	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	674.9194	0.1443	97.4117	(268)
Total CO2, kg/year			1747.7931	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			7.2800	(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	8033.4255	1.5751	12653.2982	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2851.8919	1.5219	4340.2469	(278)
Space and water heating			16993.5451	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	674.9194	1.5338	1035.2139	(282)
Total Primary energy kWh/year			18028.7590	(286)
Dwelling Primary energy Rate (DPER)			75.1200	(287)

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

1. Overall dwelling characteristics

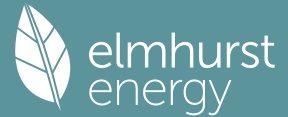
	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	146.0700	(1b) x 2.3700	(2b) =	346.1859 (1b) - (3b)
First floor	93.9200	(1c) x 2.9400	(2c) =	276.1248 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	622.3107 (5)

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) = 0.0643 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3143 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3143 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750
Adj infilt rate	0.4007	0.3928	0.3850	0.3457	0.3378	0.2986	0.2986	0.2907	0.3143	0.3378	0.3536	0.3693

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Effective ac 0.5803 0.5772 0.5741 0.5598 0.5571 0.5446 0.5446 0.5423 0.5494 0.5571 0.5625 0.5682 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			52.7100	1.1450	60.3550			(27)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Underground			146.0700	0.1300	18.9891			(28a)
External Wall	226.3500	52.7100	173.6400	0.1800	31.2552			(29a)
Rafter	150.4500	7.2900	143.1600	0.1100	15.7476			(30)
Total net area of external elements Aum(A, m2)			522.8700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		141.0877			(33)

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

133.4802 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	30.9100	0.0500	1.5455
E3 Sill	19.6000	0.0500	0.9800
E4 Jamb	56.7000	0.0500	2.8350
E5 Ground floor (normal)	53.9500	0.1600	8.6320
E6 Intermediate floor within a dwelling	27.6600	0.0000	0.0000
E11 Eaves (insulation at rafter level)	10.3200	0.0400	0.4128
E12 Gable (insulation at ceiling level)	11.6300	0.0600	0.6978
E13 Gable (insulation at rafter level)	26.3000	0.0800	2.1040
E16 Corner (normal)	14.2200	0.0900	1.2798
E17 Corner (inverted - internal area greater than external area)	4.7400	-0.0900	-0.4266
E16 Corner (normal)	5.8800	0.0900	0.5292
R1 Head of roof window	6.9400	0.0800	0.5552
R2 Sill of roof window	7.3400	0.0600	0.4404
R3 Jamb of roof window	12.8000	0.0800	1.0240

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

20.6091 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 161.6968 (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	119.1680	118.5278	117.9003	114.9528	114.4014	111.8342	111.8342	111.3588	112.8231	114.4014	115.5170	116.6833	(38)
Heat transfer coeff	280.8648	280.2246	279.5971	276.6496	276.0982	273.5310	273.5310	273.0556	274.5198	276.0982	277.2138	278.3801	(39)
Average = Sum(39)m / 12 =												276.6470	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1703	1.1677	1.1650	1.1528	1.1505	1.1398	1.1398	1.1378	1.1439	1.1505	1.1551	1.1600	(40)
HLP (average)												1.1527	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

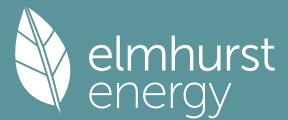
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0539 (42)
Hot water usage for mixer showers													
75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350	75.1350	(42a)
Hot water usage for baths													
32.5580	32.0745	31.3936	30.1381	29.1980	28.1556	27.5925	28.2687	29.0049	30.1203	31.4016	32.4480	32.4480	(42b)
Hot water usage for other uses													
45.9052	44.2359	42.5666	40.8973	39.2280	37.5588	37.5588	39.2280	40.8973	42.5666	44.2359	45.9052	45.9052	(42c)
Average daily hot water use (litres/day)													141.4568 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.8872	150.6009	146.5990	140.5140	135.5725	130.2600	128.2186	132.2033	136.4056	141.9828	148.1615	153.4882	(44)
Energy conte	243.7197	214.4537	225.3172	192.3567	182.5066	160.1699	155.0693	163.6953	168.2018	192.6693	211.0832	240.3254	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
36.5580	32.1681	33.7976	28.8535	27.3760	24.0255	23.2604	24.5543	25.2303	28.9004	31.6625	36.0488	36.0488	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5520 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8381 (55)
Total storage loss													
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	(56)
If cylinder contains dedicated solar storage													
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	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													
292.9624	258.9310	274.5599	240.0109	231.7493	207.8241	204.3120	212.9379	215.8560	241.9120	258.7374	289.5680	289.5680	(62)
WWHRS	-34.4807	-30.4950	-31.9326	-26.4415	-24.6425	-21.0868	-19.7655	-21.0186	-21.8172	-25.7201	-29.1377	-33.8422	(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													
258.4817	228.4359	242.6273	213.5694	207.1068	186.7373	184.5465	191.9193	194.0388	216.1919	229.5997	255.7259	255.7259	(64)
12Total per year (kWh/year)													
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													
120.4309	106.8877	114.3121	102.0820	100.0776	91.3798	90.9547	93.8228	94.0504	103.4567	108.3085	119.3023	119.3023	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567 (71)
Water heating gains (Table 5)	161.8695	159.0590	153.6453	141.7805	134.5129	126.9164	122.2509	126.1059	130.6256	139.0547	150.4285	160.3526 (72)
Total internal gains	846.9025	870.3503	832.2490	804.5455	761.7799	731.1149	701.6106	701.2357	723.2679	750.5356	797.4074	827.4000 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				1.3300	10.6334		0.6300		0.7000		0.7700		4.3221 (74)
East				28.5100	19.6403		0.6300		0.7000		0.7700		171.1261 (76)
South				3.3700	46.7521		0.6300		0.7000		0.7700		48.1507 (78)
West				19.5000	19.6403		0.6300		0.7000		0.7700		117.0452 (80)
East				2.4300	26.6072		0.6300		0.7000		1.0000		25.6618 (82)
South				2.4300	42.0754		0.6300		0.7000		1.0000		40.5803 (82)
West				2.4300	26.6072		0.6300		0.7000		1.0000		25.6618 (82)
Solar gains	432.5481	829.5762	1337.4774	1924.5294	2347.5637	2401.1050	2286.6001	1969.4153	1545.3694	975.6891	536.0578		357.9685 (83)
Total gains	1279.4505	1699.9265	2169.7263	2729.0749	3109.3436	3132.2200	2988.2107	2670.6510	2268.6373	1726.2248	1333.4653		1185.3685 (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	31.6818	31.7542	31.8255	32.1645	32.2288	32.5313	32.5313	32.5879	32.4141	32.2288	32.0991	31.9646
alpha	3.1121	3.1169	3.1217	3.1443	3.1486	3.1688	3.1688	3.1725	3.1609	3.1486	3.1399	3.1310
util living area	0.9872	0.9697	0.9285	0.8298	0.6821	0.5161	0.3890	0.4465	0.6873	0.9086	0.9763	0.9898 (86)
MIT	18.5900	18.9852	19.5638	20.2347	20.6840	20.9049	20.9708	20.9549	20.7627	20.0786	19.1982	18.5292 (87)
Th 2	19.9438	19.9460	19.9481	19.9580	19.9598	19.9685	19.9685	19.9701	19.9652	19.9598	19.9561	19.9522 (88)
util rest of house	0.9847	0.9640	0.9152	0.8001	0.6316	0.4452	0.3032	0.3554	0.6180	0.8853	0.9709	0.9878 (89)
MIT 2	17.1161	17.6185	18.3447	19.1639	19.6726	19.9013	19.9544	19.9467	19.7760	19.0016	17.8997	17.0435 (90)
Living area fraction	fLA = Living area / (4) = 0.2226 (91)											
MIT	17.4442	17.9227	18.6161	19.4023	19.8978	20.1247	20.1807	20.1711	19.9956	19.2413	18.1887	17.3742 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.4442	17.9227	18.6161	19.4023	19.8978	20.1247	20.1807	20.1711	19.9956	19.2413	18.1887	17.3742 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9755	0.9484	0.8936	0.7819	0.6284	0.4564	0.3213	0.3738	0.6202	0.8649	0.9575	0.9801 (94)
Ext temp.	1248.1467	1612.2072	1938.7780	2133.8845	1953.9233	1429.5933	960.0341	998.3723	1407.1084	1493.0444	1276.8472	1161.7831 (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	3691.7461	3649.2917	3387.6201	2905.4559	2263.3858	1511.1655	979.4249	1029.7285	1618.4687	2385.8449	3073.9490	3667.4287 (97)
Space heating requirement - total per year (kWh/year)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (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)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (98c)
Space heating per m2	(98c) / (4) = 36.9725 (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)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (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)	1969.7053	1483.1211	1167.8640	601.8759	249.4475	0.0000	0.0000	0.0000	0.0000	719.6572	1401.8562	2019.7187 (211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	258.4817	228.4359	242.6273	213.5694	207.1068	186.7373	184.5465	191.9193	194.0388	216.1919	229.5997	255.7259 (64)
Efficiency of water heater (217)m	87.5706	87.3905	86.9973	86.1034	84.2978	79.8000	79.8000	79.8000	79.8000	86.4071	87.3159	79.8000 (216)
Fuel for water heating, kWh/month	295.1695	261.3968	278.8906	248.0383	245.6847	234.0066	231.2613	240.5004	243.1564	250.2017	262.9529	291.8975 (219)

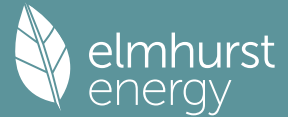
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energy

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	9613.2458	0.2100	2018.7816 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3083.1566	0.2100	647.4629 (264)
Space and water heating			2666.2445 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	344.7713	0.1443	49.7612 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1957.5186	0.1363	-266.7440
PV Unit electricity exported	-5262.3571	0.1266	-666.3209
Total			-933.0649 (269)
Total CO2, kg/year			1794.8700 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.4800 (273)

13a. Primary energy - Individual heating systems including micro-CHP			
	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	9613.2458	1.1300	10862.9678 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	3083.1566	1.1300	3483.9669 (278)
Space and water heating			14346.9347 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	344.7713	1.5338	528.8218 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1957.5186	1.5037	-2943.5386
PV Unit electricity exported	-5262.3571	0.4648	-2446.0187
Total			-5389.5573 (283)
Total Primary energy kWh/year			9616.2999 (286)
Target Primary Energy Rate (TPER)			40.0700 (287)

ii. Be Lean

Full SAP Calculation Printout



Property Reference	Flint House				Issued on Date	14/03/2024
Assessment Reference	Option 2	Prop Type Ref		Flint House		
Property	Land Adj to, Flint House, ROYSTON, SG8 9SD					
SAP Rating	74 C	DER	4.81	TER	7.48	
Environmental	95 A	% DER < TER				35.70
CO ₂ Emissions (t/year)	1.08	DFEE	40.06	TFEE	43.01	
Compliance Check	See BREL	% DFEE < TFEE				6.86
% DPER < TPER	-24.39	DPER	49.84	TPER	40.07	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	146.0700 (1b)	x 2.3700 (2b)	= 346.1859 (1b) - (3b)
First floor	93.9200 (1c)	x 2.9400 (2c)	= 276.1248 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	622.3107 (5)

2. Ventilation rate

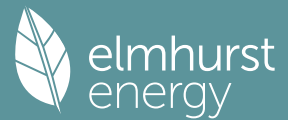
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.0643 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2143 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2143 (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	0.2732	0.2678	0.2625	0.2357	0.2303	0.2036	0.2036	0.1982	0.2143	0.2303	0.2411	0.2518 (22b)
Effective ac	0.5373	0.5359	0.5345	0.5278	0.5265	0.5207	0.5207	0.5196	0.5230	0.5265	0.5291	0.5317 (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
Windows (Uw = 1.20)			52.8900	1.1450	60.5611		(27)
Rooflights			2.4400	1.1450	2.7939		(27a)
Rooflights			2.4400	1.1450	2.7939		(27a)
Rooflights			2.4400	1.1450	2.7939		(27a)
Underground			146.0700	0.1000	14.6070	110.0000	16067.7000 (28a)
External Wall	226.3500	52.8900	173.4600	0.1400	24.2844	70.0000	12142.2000 (29a)
Rafter	150.4500	7.3200	143.1300	0.1100	15.7443	9.0000	1288.1700 (30)
Total net area of external elements Aum(A, m ²)			522.8700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	123.5784			(33)
FF			93.9200			18.0000	1690.5600 (32d)
GF			93.9200			9.0000	845.2800 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	32033.9100 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							133.4802 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				30.9100	0.3000	9.2730	
E3 Sill				19.6000	0.0400	0.7840	
E4 Jamb				56.7000	0.0500	2.8350	

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E5 Ground floor (normal)	53.9500	0.1600	8.6320
E6 Intermediate floor within a dwelling	27.6600	0.0600	1.6596
E11 Eaves (insulation at rafter level)	10.3200	0.0400	0.4128
E12 Gable (insulation at ceiling level)	11.6300	0.2400	2.7912
E13 Gable (insulation at rafter level)	26.3000	0.0400	1.0520
E16 Corner (normal)	14.2200	0.0900	1.2798
E17 Corner (inverted - internal area greater than external area)	4.7400	-0.0900	-0.4266
E16 Corner (normal)	5.8800	0.0900	0.5292
R1 Head of roof window	6.9400	0.0800	0.5552
R2 Sill of roof window	7.3400	0.0600	0.4404
R3 Jamb of roof window	12.8000	0.0800	1.0240
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			30.8416 (36)
Point Thermal Bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	154.4200 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	110.3454	110.0478	109.7560	108.3859	108.1295	106.9362	106.9362	106.7152	107.3958	108.1295	108.6481	109.1903 (38)
Average = Sum(39)m / 12 =	264.7654	264.4678	264.1761	262.8059	262.5496	261.3562	261.3562	261.1352	261.8159	262.5496	263.0682	263.6103 (39)
												262.8047
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1032	1.1020	1.1008	1.0951	1.0940	1.0890	1.0890	1.0881	1.0909	1.0940	1.0962	1.0984 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0539 (42)
Hot water usage for mixer showers	75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350 (42a)
Hot water usage for baths	34.2716	33.7626	33.0459	31.7243	30.7347	29.6375	29.0448	29.7565	30.5315	31.7056	33.0544	34.1557 (42b)
Hot water usage for other uses	48.3212	46.5641	44.8070	43.0498	41.2927	39.5355	39.5355	41.2927	43.0498	44.8070	46.5641	48.3212 (42c)
Average daily hot water use (litres/day)												145.2420 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	158.0168	154.6173	150.4917	144.2527	139.1739	133.7187	131.6477	135.7557	140.0847	145.8084	152.1424	157.6120 (44)
Energy content (annual)	250.2601	220.1729	231.3001	197.4748	187.3548	164.4227	159.2164	168.0939	172.7384	197.8607	216.7548	246.7823 (45)
Distribution loss (46)m = 0.15 x (45)m	37.5390	33.0259	34.6950	29.6212	28.1032	24.6634	23.8825	25.2141	25.9108	29.6791	32.5132	37.0173 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												0.8400 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.4536 (55)
Total storage loss	14.0616	12.7008	14.0616	13.6080	14.0616	13.6080	14.0616	14.0616	13.6080	14.0616	13.6080	14.0616 (56)
If cylinder contains dedicated solar storage	14.0616	12.7008	14.0616	13.6080	14.0616	13.6080	14.0616	14.0616	13.6080	14.0616	13.6080	14.0616 (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	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (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	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (64)
12Total per year (kWh/year)												2851.8919 (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	113.0707	100.1771	106.7665	94.5564	92.1547	83.5665	82.7987	85.7504	86.3315	95.6479	100.9670	111.9143 (65)

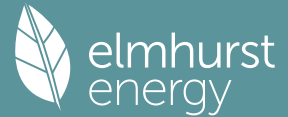
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696 (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)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567 (71)
Water heating gains (Table 5)	151.9767	149.0731	143.5033	131.3283	123.8638	116.0646	111.2885	115.2560	119.9049	128.5590	140.2319	150.4225 (72)
Total internal gains	834.0096	857.3644	819.1070	791.0933	748.1308	720.2631	690.6482	690.3858	712.5472	737.0399	784.2108	814.4699 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.3300	10.6334	0.6300	0.7000	0.7700	4.3221 (74)
East	28.6100	19.6403	0.6300	0.7000	0.7700	171.7264 (76)
South	3.3800	46.7521	0.6300	0.7000	0.7700	48.2936 (78)
West	19.5700	19.6403	0.6300	0.7000	0.7700	117.4654 (80)

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East			2.4400		26.6072		0.6300		0.7000		1.0000		25.7674 (82)
South			2.4400		42.0754		0.6300		0.7000		1.0000		40.7473 (82)
West			2.4400		26.6072		0.6300		0.7000		1.0000		25.7674 (82)

Solar gains	434.0895	832.5418	1342.2752	1931.4486	2356.0107	2409.7461	2294.8286	1976.4990	1550.9189	979.1820	537.9700	359.2429 (83)
Total gains	1268.0992	1689.9062	2161.3822	2722.5419	3104.1415	3130.0093	2985.4768	2666.8848	2263.4661	1716.2220	1322.1808	1173.7128 (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	33.6083	33.6461	33.6832	33.8589	33.8919	34.0467	34.0467	34.0755	33.9869	33.8919	33.8251	33.7555	
alpha	3.2406	3.2431	3.2455	3.2573	3.2595	3.2698	3.2698	3.2717	3.2658	3.2595	3.2550	3.2504	
util living area	0.9875	0.9693	0.9254	0.8207	0.6667	0.5000	0.3745	0.4316	0.6733	0.9051	0.9764	0.9902 (86)	
Living	19.2009	19.4959	19.9203	20.3959	20.7050	20.8477	20.8888	20.8788	20.7533	20.2710	19.6308	19.1465	
Non living	17.8705	18.2452	18.7771	19.3546	19.7021	19.8477	19.8807	19.8757	19.7655	19.2231	18.4234	17.8039	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	15	0	0	0	0	0	0	30	31	
16 / 9	0	0	0	15	0	0	0	0	0	16	0	0	
MIT	21.0000	21.0000	21.0000	20.8289	20.7050	20.8477	20.8888	20.8788	20.7533	20.4341	21.0000	21.0000 (87)	
Th 2	19.9982	19.9992	20.0002	20.0049	20.0057	20.0098	20.0098	20.0106	20.0082	20.0057	20.0040	20.0021 (88)	
util rest of house	0.9851	0.9636	0.9120	0.7910	0.6175	0.4327	0.2945	0.3458	0.6057	0.8817	0.9711	0.9882 (89)	
MIT 2	19.9982	19.9992	20.0002	19.8614	19.7021	19.8477	19.8807	19.8757	19.7655	19.4487	20.0040	20.0021 (90)	
Living area fraction									fLA = Living area / (4) =			0.2226 (91)	
MIT	20.2212	20.2220	20.2227	20.0767	19.9253	20.0703	20.1051	20.0990	19.9854	19.6681	20.2257	20.2242 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.2212	20.2220	20.2227	20.0767	19.9253	20.0703	20.1051	20.0990	19.9854	19.6681	20.2257	20.2242 (93)	

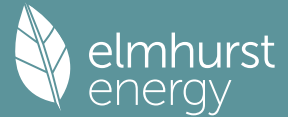
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9857	0.9650	0.9152	0.7933	0.6132	0.4369	0.3023	0.3538	0.6040	0.8723	0.9724	0.9887 (94)	
Useful gains	1249.9077	1630.6878	1978.0799	2159.7402	1903.5856	1367.6023	902.6553	943.4222	1367.0680	1497.0107	1285.7055	1160.4608 (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	4215.3797	4052.1688	3625.2213	2937.3105	2159.5553	1429.7039	916.0803	965.9300	1540.8890	2380.8201	3452.9479	4224.1560 (97)	
Space heating kWh	2206.3111	1627.2352	1225.4732	559.8506	190.4414	0.0000	0.0000	0.0000	0.0000	657.5542	1560.4145	2279.3893 (98a)	
Space heating requirement - total per year (kWh/year)												10306.6697	
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	2206.3111	1627.2352	1225.4732	559.8506	190.4414	0.0000	0.0000	0.0000	0.0000	657.5542	1560.4145	2279.3893 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												10306.6697	
Space heating per m2										(98c) / (4) =		42.9462 (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 %)													228.1204 (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	2206.3111	1627.2352	1225.4732	559.8506	190.4414	0.0000	0.0000	0.0000	0.0000	657.5542	1560.4145	2279.3893 (98)	
Space heating efficiency (main heating system 1)	228.1204	228.1204	228.1204	228.1204	228.1204	0.0000	0.0000	0.0000	0.0000	228.1204	228.1204	228.1204 (210)	
Space heating fuel (main heating system)	967.1697	713.3231	537.2046	245.4190	83.4829	0.0000	0.0000	0.0000	0.0000	288.2488	684.0312	999.2046 (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	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (64)	
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)	
Fuel for water heating, kWh/month	287.5841	253.8849	268.6241	233.5948	224.6788	200.5427	196.5404	205.4179	208.8584	235.1847	252.8748	284.1063 (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	39.7508	31.8896	28.7130	21.0364	16.2491	13.2757	14.8230	19.2675	25.0265	32.8362	37.0884	40.8556 (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	4518.0839	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	100.0000	
Water heating fuel used	2851.8919	(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)	320.8117	(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	7690.7875	(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	4518.0839	0.1561	705.4482	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2851.8919	0.1411	402.5061	(264)
Space and water heating			1107.9543	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	320.8117	0.1443	46.3030	(268)
Total CO2, kg/year			1154.2574	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.8100	(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	4518.0839	1.5780	7129.6676	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2851.8919	1.5219	4340.2469	(278)
Space and water heating			11469.9145	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	320.8117	1.5338	492.0717	(282)
Total Primary energy kWh/year			11961.9862	(286)
Dwelling Primary energy Rate (DPER)			49.8400	(287)

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

1. Overall dwelling characteristics

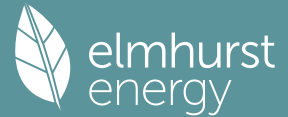
	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	146.0700	(1b) x 2.3700	(2b) =	346.1859 (1b) - (3b)
First floor	93.9200	(1c) x 2.9400	(2c) =	276.1248 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900			(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	622.3107 (5)

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) =	0.0643 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3143	(18)
Number of sides sheltered	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3143 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750
Adj infilt rate	0.4007	0.3928	0.3850	0.3457	0.3378	0.2986	0.2986	0.2907	0.3143	0.3378	0.3536	0.3693

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Effective ac 0.5803 0.5772 0.5741 0.5598 0.5571 0.5446 0.5446 0.5423 0.5494 0.5571 0.5625 0.5682 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			52.7100	1.1450	60.3550			(27)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Underground			146.0700	0.1300	18.9891			(28a)
External Wall	226.3500	52.7100	173.6400	0.1800	31.2552			(29a)
Rafter	150.4500	7.2900	143.1600	0.1100	15.7476			(30)
Total net area of external elements Aum(A, m2)			522.8700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		141.0877			(33)

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

133.4802 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	30.9100	0.0500	1.5455
E3 Sill	19.6000	0.0500	0.9800
E4 Jamb	56.7000	0.0500	2.8350
E5 Ground floor (normal)	53.9500	0.1600	8.6320
E6 Intermediate floor within a dwelling	27.6600	0.0000	0.0000
E11 Eaves (insulation at rafter level)	10.3200	0.0400	0.4128
E12 Gable (insulation at ceiling level)	11.6300	0.0600	0.6978
E13 Gable (insulation at rafter level)	26.3000	0.0800	2.1040
E16 Corner (normal)	14.2200	0.0900	1.2798
E17 Corner (inverted - internal area greater than external area)	4.7400	-0.0900	-0.4266
E16 Corner (normal)	5.8800	0.0900	0.5292
R1 Head of roof window	6.9400	0.0800	0.5552
R2 Sill of roof window	7.3400	0.0600	0.4404
R3 Jamb of roof window	12.8000	0.0800	1.0240

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

20.6091 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 161.6968 (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	119.1680	118.5278	117.9003	114.9528	114.4014	111.8342	111.8342	111.3588	112.8231	114.4014	115.5170	116.6833	(38)
Heat transfer coeff	280.8648	280.2246	279.5971	276.6496	276.0982	273.5310	273.5310	273.0556	274.5198	276.0982	277.2138	278.3801	(39)
Average = Sum(39)m / 12 =												276.6470	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1703	1.1677	1.1650	1.1528	1.1505	1.1398	1.1398	1.1378	1.1439	1.1505	1.1551	1.1600	(40)
HLP (average)												1.1527	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

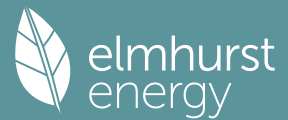
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0539 (42)
Hot water usage for mixer showers													
75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350	75.1350	(42a)
Hot water usage for baths													
32.5580	32.0745	31.3936	30.1381	29.1980	28.1556	27.5925	28.2687	29.0049	30.1203	31.4016	32.4480	32.4480	(42b)
Hot water usage for other uses													
45.9052	44.2359	42.5666	40.8973	39.2280	37.5588	37.5588	39.2280	40.8973	42.5666	44.2359	45.9052	45.9052	(42c)
Average daily hot water use (litres/day)													141.4568 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.8872	150.6009	146.5990	140.5140	135.5725	130.2600	128.2186	132.2033	136.4056	141.9828	148.1615	153.4882	(44)
Energy conte	243.7197	214.4537	225.3172	192.3567	182.5066	160.1699	155.0693	163.6953	168.2018	192.6693	211.0832	240.3254	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
36.5580	32.1681	33.7976	28.8535	27.3760	24.0255	23.2604	24.5543	25.2303	28.9004	31.6625	36.0488	36.0488	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5520 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8381 (55)
Total storage loss													
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	(56)
If cylinder contains dedicated solar storage													
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	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													
292.9624	258.9310	274.5599	240.0109	231.7493	207.8241	204.3120	212.9379	215.8560	241.9120	258.7374	289.5680	289.5680	(62)
WWHRS	-34.4807	-30.4950	-31.9326	-26.4415	-24.6425	-21.0868	-19.7655	-21.0186	-21.8172	-25.7201	-29.1377	-33.8422	(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													
258.4817	228.4359	242.6273	213.5694	207.1068	186.7373	184.5465	191.9193	194.0388	216.1919	229.5997	255.7259	255.7259	(64)
12Total per year (kWh/year)													
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													
120.4309	106.8877	114.3121	102.0820	100.0776	91.3798	90.9547	93.8228	94.0504	103.4567	108.3085	119.3023	119.3023	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567 (71)
Water heating gains (Table 5)	161.8695	159.0590	153.6453	141.7805	134.5129	126.9164	122.2509	126.1059	130.6256	139.0547	150.4285	160.3526 (72)
Total internal gains	846.9025	870.3503	832.2490	804.5455	761.7799	731.1149	701.6106	701.2357	723.2679	750.5356	797.4074	827.4000 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				1.3300	10.6334		0.6300		0.7000		0.7700		4.3221 (74)
East				28.5100	19.6403		0.6300		0.7000		0.7700		171.1261 (76)
South				3.3700	46.7521		0.6300		0.7000		0.7700		48.1507 (78)
West				19.5000	19.6403		0.6300		0.7000		0.7700		117.0452 (80)
East				2.4300	26.6072		0.6300		0.7000		1.0000		25.6618 (82)
South				2.4300	42.0754		0.6300		0.7000		1.0000		40.5803 (82)
West				2.4300	26.6072		0.6300		0.7000		1.0000		25.6618 (82)
Solar gains	432.5481	829.5762	1337.4774	1924.5294	2347.5637	2401.1050	2286.6001	1969.4153	1545.3694	975.6891	536.0578		357.9685 (83)
Total gains	1279.4505	1699.9265	2169.7263	2729.0749	3109.3436	3132.2200	2988.2107	2670.6510	2268.6373	1726.2248	1333.4653		1185.3685 (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	31.6818	31.7542	31.8255	32.1645	32.2288	32.5313	32.5313	32.5879	32.4141	32.2288	32.0991	31.9646
alpha	3.1121	3.1169	3.1217	3.1443	3.1486	3.1688	3.1688	3.1725	3.1609	3.1486	3.1399	3.1310
util living area	0.9872	0.9697	0.9285	0.8298	0.6821	0.5161	0.3890	0.4465	0.6873	0.9086	0.9763	0.9898 (86)
MIT	18.5900	18.9852	19.5638	20.2347	20.6840	20.9049	20.9708	20.9549	20.7627	20.0786	19.1982	18.5292 (87)
Th 2	19.9438	19.9460	19.9481	19.9580	19.9598	19.9685	19.9685	19.9701	19.9652	19.9598	19.9561	19.9522 (88)
util rest of house	0.9847	0.9640	0.9152	0.8001	0.6316	0.4452	0.3032	0.3554	0.6180	0.8853	0.9709	0.9878 (89)
MIT 2	17.1161	17.6185	18.3447	19.1639	19.6726	19.9013	19.9544	19.9467	19.7760	19.0016	17.8997	17.0435 (90)
Living area fraction									fLA = Living area / (4) =			0.2226 (91)
MIT	17.4442	17.9227	18.6161	19.4023	19.8978	20.1247	20.1807	20.1711	19.9956	19.2413	18.1887	17.3742 (92)
Temperature adjustment												0.0000
adjusted MIT	17.4442	17.9227	18.6161	19.4023	19.8978	20.1247	20.1807	20.1711	19.9956	19.2413	18.1887	17.3742 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9755	0.9484	0.8936	0.7819	0.6284	0.4564	0.3213	0.3738	0.6202	0.8649	0.9575	0.9801 (94)
Ext temp.	1248.1467	1612.2072	1938.7780	2133.8845	1953.9233	1429.5933	960.0341	998.3723	1407.1084	1493.0444	1276.8472	1161.7831 (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	3691.7461	3649.2917	3387.6201	2905.4559	2263.3858	1511.1655	979.4249	1029.7285	1618.4687	2385.8449	3073.9490	3667.4287 (97)
Space heating requirement - total per year (kWh/year)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (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)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8873.0259
Space heating per m2										(98c) / (4) =		36.9725 (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)	1818.0380	1368.9208	1077.9385	555.5314	230.2401	0.0000	0.0000	0.0000	0.0000	664.2436	1293.9133	1864.2003 (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)	1969.7053	1483.1211	1167.8640	601.8759	249.4475	0.0000	0.0000	0.0000	0.0000	719.6572	1401.8562	2019.7187 (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)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	258.4817	228.4359	242.6273	213.5694	207.1068	186.7373	184.5465	191.9193	194.0388	216.1919	229.5997	255.7259 (64)
Efficiency of water heater (217)m	87.5706	87.3905	86.9973	86.1034	84.2978	79.8000	79.8000	79.8000	79.8000	86.4071	87.3159	79.8000 (216)
Fuel for water heating, kWh/month	295.1695	261.3968	278.8906	248.0383	245.6847	234.0066	231.2613	240.5004	243.1564	250.2017	262.9529	291.8975 (219)

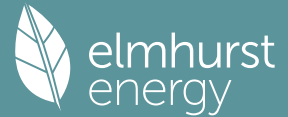
elmhurst
energy

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	9613.2458	0.2100	2018.7816 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3083.1566	0.2100	647.4629 (264)
Space and water heating			2666.2445 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	344.7713	0.1443	49.7612 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1957.5186	0.1363	-266.7440
PV Unit electricity exported	-5262.3571	0.1266	-666.3209
Total			-933.0649 (269)
Total CO2, kg/year			1794.8700 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.4800 (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	9613.2458	1.1300	10862.9678 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3083.1566	1.1300	3483.9669 (278)
Space and water heating			14346.9347 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	344.7713	1.5338	528.8218 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1957.5186	1.5037	-2943.5386
PV Unit electricity exported	-5262.3571	0.4648	-2446.0187
Total			-5389.5573 (283)
Total Primary energy kWh/year			9616.2999 (286)
Target Primary Energy Rate (TPER)			40.0700 (287)

iii. Be Green

Full SAP Calculation Printout



Property Reference	Flint House				Issued on Date	14/03/2024
Assessment Reference	Option 3	Prop Type Ref		Flint House		
Property	Land Adj to, Flint House, ROYSTON, SG8 9SD					
SAP Rating	92 A	DER	1.35	TER	7.49	
Environmental	99 A	% DER < TER				81.98
CO ₂ Emissions (t/year)	0.27	DFEE	40.06	TFEE	43.01	
Compliance Check	See BREL	% DFEE < TFEE				6.86
% DPER < TPER	58.13	DPER	16.81	TPER	40.15	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	146.0700 (1b)	x 2.3700 (2b)	= 346.1859 (1b) - (3b)
First floor	93.9200 (1c)	x 2.9400 (2c)	= 276.1248 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 622.3107 (5)

2. Ventilation rate

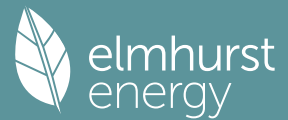
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.0643 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2143 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2143 (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	0.2732	0.2678	0.2625	0.2357	0.2303	0.2036	0.2036	0.1982	0.2143	0.2303	0.2411	0.2518 (22b)
Effective ac	0.5373	0.5359	0.5345	0.5278	0.5265	0.5207	0.5207	0.5196	0.5230	0.5265	0.5291	0.5317 (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
Windows (Uw = 1.20)			52.8900	1.1450	60.5611		(27)
Rooflights			2.4400	1.1450	2.7939		(27a)
Rooflights			2.4400	1.1450	2.7939		(27a)
Rooflights			2.4400	1.1450	2.7939		(27a)
Underground			146.0700	0.1000	14.6070	110.0000	16067.7000 (28a)
External Wall	226.3500	52.8900	173.4600	0.1400	24.2844	70.0000	12142.2000 (29a)
Rafter	150.4500	7.3200	143.1300	0.1100	15.7443	9.0000	1288.1700 (30)
Total net area of external elements Aum(A, m ²)			522.8700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	123.5784			(33)
FF			93.9200			18.0000	1690.5600 (32d)
GF			93.9200			9.0000	845.2800 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	32033.9100			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							133.4802 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				30.9100	0.3000	9.2730	
E3 Sill				19.6000	0.0400	0.7840	
E4 Jamb				56.7000	0.0500	2.8350	

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E5 Ground floor (normal)	53.9500	0.1600	8.6320
E6 Intermediate floor within a dwelling	27.6600	0.0600	1.6596
E11 Eaves (insulation at rafter level)	10.3200	0.0400	0.4128
E12 Gable (insulation at ceiling level)	11.6300	0.2400	2.7912
E13 Gable (insulation at rafter level)	26.3000	0.0400	1.0520
E16 Corner (normal)	14.2200	0.0900	1.2798
E17 Corner (inverted - internal area greater than external area)	4.7400	-0.0900	-0.4266
E16 Corner (normal)	5.8800	0.0900	0.5292
R1 Head of roof window	6.9400	0.0800	0.5552
R2 Sill of roof window	7.3400	0.0600	0.4404
R3 Jamb of roof window	12.8000	0.0800	1.0240
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			30.8416 (36)
Point Thermal Bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	154.4200 (37)

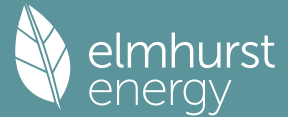
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	110.3454	110.0478	109.7560	108.3859	108.1295	106.9362	106.9362	106.7152	107.3958	108.1295	108.6481	109.1903 (38)
Average = Sum(39)m / 12 =	264.7654	264.4678	264.1761	262.8059	262.5496	261.3562	261.3562	261.1352	261.8159	262.5496	263.0682	263.6103 (39)
												262.8047
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1032	1.1020	1.1008	1.0951	1.0940	1.0890	1.0890	1.0881	1.0909	1.0940	1.0962	1.0984 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												3.0539 (42)
Hot water usage for mixer showers	75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350 (42a)
Hot water usage for baths	34.2716	33.7626	33.0459	31.7243	30.7347	29.6375	29.0448	29.7565	30.5315	31.7056	33.0544	34.1557 (42b)
Hot water usage for other uses	48.3212	46.5641	44.8070	43.0498	41.2927	39.5355	39.5355	41.2927	43.0498	44.8070	46.5641	48.3212 (42c)
Average daily hot water use (litres/day)												145.2420 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	158.0168	154.6173	150.4917	144.2527	139.1739	133.7187	131.6477	135.7557	140.0847	145.8084	152.1424	157.6120 (44)
Energy content (annual)	250.2601	220.1729	231.3001	197.4748	187.3548	164.4227	159.2164	168.0939	172.7384	197.8607	216.7548	246.7823 (45)
Distribution loss (46)m = 0.15 x (45)m	37.5390	33.0259	34.6950	29.6212	28.1032	24.6634	23.8825	25.2141	25.9108	29.6791	32.5132	37.0173 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1340 (55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540 (56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540 (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	308.6765	272.9361	289.7165	254.0068	245.7712	220.9547	217.6328	226.5103	229.2704	256.2771	273.2868	305.1987 (62)
WWHRS	-36.6038	-32.3727	-33.8988	-28.0696	-26.1598	-22.3852	-20.9825	-22.3128	-23.1605	-27.3037	-30.9318	-35.9260 (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	272.0727	240.5634	255.8177	225.9372	219.6114	198.5695	196.6503	204.1976	206.1099	228.9733	242.3550	269.2728 (64)
12Total per year (kWh/year)												2760.1307 (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	129.9446	115.4181	123.6404	110.8860	109.0286	99.8961	99.6726	102.6244	102.6611	112.5218	117.2966	128.7882 (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	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696 (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)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567 (71)
Water heating gains (Table 5)	174.6567	171.7531	166.1833	154.0083	146.5438	138.7446	133.9685	137.9360	142.5849	151.2390	162.9119	173.1025 (72)
Total internal gains	856.6896	880.0444	841.7870	813.7733	770.8108	742.9431	713.3282	713.0658	735.2272	759.7199	806.8908	837.1499 (73)

6. Solar gains							
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3300	10.6334	0.6300	0.7000	0.7700	4.3221 (74)	
East	28.6100	19.6403	0.6300	0.7000	0.7700	171.7264 (76)	
South	3.3800	46.7521	0.6300	0.7000	0.7700	48.2936 (78)	
West	19.5700	19.6403	0.6300	0.7000	0.7700	117.4654 (80)	

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East		2.4400		26.6072		0.6300		0.7000		1.0000		25.7674 (82)
South		2.4400		42.0754		0.6300		0.7000		1.0000		40.7473 (82)
West		2.4400		26.6072		0.6300		0.7000		1.0000		25.7674 (82)

Solar gains	434.0895	832.5418	1342.2752	1931.4486	2356.0107	2409.7461	2294.8286	1976.4990	1550.9189	979.1820	537.9700	359.2429 (83)
Total gains	1290.7792	1712.5862	2184.0622	2745.2219	3126.8215	3152.6893	3008.1568	2689.5648	2286.1461	1738.9020	1344.8608	1196.3928 (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	33.6083	33.6461	33.6832	33.8589	33.8919	34.0467	34.0467	34.0755	33.9869	33.8919	33.8251	33.7555
alpha	3.2406	3.2431	3.2455	3.2573	3.2595	3.2698	3.2698	3.2717	3.2658	3.2595	3.2550	3.2504
util living area	0.9868	0.9682	0.9236	0.8179	0.6636	0.4970	0.3719	0.4284	0.6690	0.9023	0.9753	0.9896 (86)
Living	19.2125	19.5067	19.9294	20.4019	20.7078	20.8487	20.8891	20.8794	20.7562	20.2794	19.6420	19.1582
Non living	17.8853	18.2588	18.7881	19.3613	19.7049	19.8485	19.8809	19.8760	19.7681	19.2329	18.4374	17.8189
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.0856	19.5067	19.9294	20.4019	20.7078	20.8487	20.8891	20.8794	20.7562	20.2794	19.6420	19.4158 (87)
Th 2	19.9982	19.9992	20.0002	20.0049	20.0057	20.0098	20.0098	20.0106	20.0082	20.0057	20.0040	20.0021 (88)
util rest of house	0.9843	0.9623	0.9098	0.7880	0.6143	0.4299	0.2923	0.3431	0.6013	0.8784	0.9698	0.9876 (89)
MIT 2	19.1558	18.2588	18.7881	19.3613	19.7049	19.8485	19.8809	19.8760	19.7681	19.2329	18.4374	18.2123 (90)
Living area fraction									fLA = Living area / (4) =			0.2226 (91)
MIT	19.3628	18.5365	19.0422	19.5929	19.9281	20.0712	20.1053	20.0994	19.9881	19.4658	18.7055	18.4802 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3628	18.5365	19.0422	19.5929	19.9281	20.0712	20.1053	20.0994	19.9881	19.4658	18.7055	18.4802 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9824	0.9510	0.8938	0.7740	0.6102	0.4342	0.3002	0.3510	0.5998	0.8625	0.9600	0.9834 (94)
Useful gains	1268.0244	1628.6674	1952.0566	2124.7220	1907.9954	1368.9341	902.9962	944.0357	1371.2360	1499.8620	1291.0351	1176.5773 (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	3988.1072	3606.4262	3313.3456	2810.1601	2160.2929	1429.9191	916.1372	966.0316	1541.5894	2327.7223	3053.0405	3764.4062 (97)
Space heating kWh	2023.7416	1329.0539	1012.7990	493.5155	187.7094	0.0000	0.0000	0.0000	0.0000	615.9280	1268.6439	1925.3447 (98a)
Space heating requirement - total per year (kWh/year)												8856.7360
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	2023.7416	1329.0539	1012.7990	493.5155	187.7094	0.0000	0.0000	0.0000	0.0000	615.9280	1268.6439	1925.3447 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8856.7360
Space heating per m2										(98c) / (4) =		36.9046 (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 %)												370.3886 (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	2023.7416	1329.0539	1012.7990	493.5155	187.7094	0.0000	0.0000	0.0000	0.0000	615.9280	1268.6439	1925.3447 (98)
Space heating efficiency (main heating system 1)	370.3886	370.3886	370.3886	370.3886	370.3886	0.0000	0.0000	0.0000	0.0000	370.3886	370.3886	370.3886 (210)
Space heating fuel (main heating system)	546.3833	358.8269	273.4423	133.2426	50.6790	0.0000	0.0000	0.0000	0.0000	166.2924	342.5170	519.8174 (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	272.0727	240.5634	255.8177	225.9372	219.6114	198.5695	196.6503	204.1976	206.1099	228.9733	242.3550	269.2728 (64)
Efficiency of water heater (217)m	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087	218.2087 (216)
Fuel for water heating, kWh/month	124.6846	110.2447	117.2353	103.5418	100.6428	90.9998	90.1203	93.5790	94.4554	104.9332	111.0657	123.4015 (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	39.7508	31.8896	28.7130	21.0364	16.2491	13.2757	14.8230	19.2675	25.0265	32.8362	37.0884	40.8556 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-42.6364	-65.0881	-103.9825	-130.0388	-149.0976	-139.0745	-135.7681	-120.4370	-96.8298	-76.3481	-47.9677	-36.2305 (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	-9.9251	-23.5499	-55.5959	-106.2370	-169.6505	-187.1844	-180.5975	-136.6003	-85.1213	-38.6979	-14.4166	-7.8081 (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	2391.2008	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	218.2087	
Water heating fuel used	1264.9043	(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)	320.8117	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2158.8835	(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	1818.0332	(238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year	
Space heating - main system 1	2391.2008	0.1560	373.1188	(261)
Total CO ₂ associated with community systems			0.0000	(373)
Water heating (other fuel)	1264.9043	0.1408	178.0751	(264)
Space and water heating			551.1939	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	320.8117	0.1443	46.3030	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1143.4991	0.1331	-152.1430	
PV Unit electricity exported	-1015.3844	0.1203	-122.1269	
Total			-274.2698	(269)
Total CO ₂ , kg/year			323.2271	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.3500	(273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year	
Space heating - main system 1	2391.2008	1.5776	3772.4279	(275)
Total CO ₂ associated with community systems			0.0000	(473)
Water heating (other fuel)	1264.9043	1.5206	1923.3537	(278)
Space and water heating			5695.7817	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	320.8117	1.5338	492.0717	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1143.4991	1.4916	-1705.6991	
PV Unit electricity exported	-1015.3844	0.4411	-447.9229	
Total			-2153.6220	(283)
Total Primary energy kWh/year			4034.2314	(286)
Dwelling Primary energy Rate (DPER)			16.8100	(287)

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

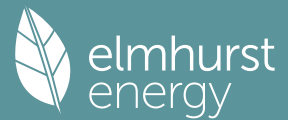
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	146.0700 (1b)	x 2.3700 (2b)	= 346.1859 (1b) - (3b)	
First floor	93.9200 (1c)	x 2.9400 (2c)	= 276.1248 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	239.9900			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 622.3107	(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	40.0000 / (5) =	0.0643 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3143	(18)
Number of sides sheltered	0	(19)

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Shelter factor
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 1.0000 \quad (20)$$
$$(21) = (18) \times (20) = 0.3143 \quad (21)$$

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infiltr rate	0.4007	0.3928	0.3850	0.3457	0.3378	0.2986	0.2986	0.2907	0.3143	0.3378	0.3536	0.3693	(22b)
Effective ac	0.5803	0.5772	0.5741	0.5598	0.5571	0.5446	0.5446	0.5423	0.5494	0.5571	0.5625	0.5682	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			52.7100	1.1450	60.3550			(27)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Rooflights			2.4300	2.0221	4.9136			(27a)
Underground			146.0700	0.1300	18.9891			(28a)
External Wall	226.3500	52.7100	173.6400	0.1800	31.2552			(29a)
Rafter	150.4500	7.2900	143.1600	0.1100	15.7476			(30)
Total net area of external elements Aum(A, m2)			522.8700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	141.0877			(33)

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

133.4802 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	30.9100	0.0500	1.5455
E2 Other lintels (including other steel lintels)	19.6000	0.0500	0.9800
E3 Sill	56.7000	0.0500	2.8350
E4 Jamb	53.9500	0.1600	8.6320
E5 Ground floor (normal)	27.6600	0.0000	0.0000
E6 Intermediate floor within a dwelling	10.3200	0.0400	0.4128
E11 Eaves (insulation at rafter level)	11.6300	0.0600	0.6978
E12 Gable (insulation at ceiling level)	26.3000	0.0800	2.1040
E13 Gable (insulation at rafter level)	14.2200	0.0900	1.2798
E16 Corner (normal)	4.7400	-0.0900	-0.4266
E17 Corner (inverted - internal area greater than external area)	5.8800	0.0900	0.5292
E16 Corner (normal)	6.9400	0.0800	0.5552
R1 Head of roof window	7.3400	0.0600	0.4404
R2 Sill of roof window	12.8000	0.0800	1.0240
R3 Jamb of roof window			

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

20.6091 (36)

Point Thermal Bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 161.6968 (37)

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

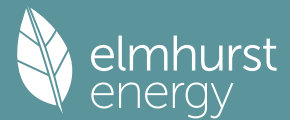
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	119.1680	118.5278	117.9003	114.9528	114.4014	111.8342	111.8342	111.3588	112.8231	114.4014	115.5170	116.6833	(38)
Average = Sum(39)m / 12 =	280.8648	280.2246	279.5971	276.6496	276.0982	273.5310	273.5310	273.0556	274.5198	276.0982	277.2138	278.3801	(39)
												276.6470	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.1703	1.1677	1.1650	1.1528	1.1505	1.1398	1.1398	1.1378	1.1439	1.1505	1.1551	1.1600	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0539 (42)
Hot water usage for mixer showers	75.4240	74.2905	72.6388	69.4786	67.1465	64.5456	63.0673	64.7065	66.5034	69.2959	72.5240	75.1350	(42a)
Hot water usage for baths	32.5580	32.0745	31.3936	30.1381	29.1980	28.1556	27.5925	28.2687	29.0049	30.1203	31.4016	32.4480	(42b)
Hot water usage for other uses	45.9052	44.2359	42.5666	40.8973	39.2280	37.5588	37.5588	39.2280	40.8973	42.5666	44.2359	45.9052	(42c)
Average daily hot water use (litres/day)													141.4568 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	153.8872	150.6009	146.5990	140.5140	135.5725	130.2600	128.2186	132.2033	136.4056	141.9828	148.1615	153.4882	(44)
Energy conte	243.7197	214.4537	225.3172	192.3567	182.5066	160.1699	155.0693	163.6953	168.2018	192.6693	211.0832	240.3254	(45)
Energy content (annual)										Total = Sum(45)m =			2349.5682
Distribution loss (46)m = 0.15 x (45)m	36.5580	32.1681	33.7976	28.8535	27.3760	24.0255	23.2604	24.5543	25.2303	28.9004	31.6625	36.0488	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6525 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	294.6458	260.4514	276.2433	241.6400	233.4327	209.4532	205.9954	214.6213	217.4851	243.5954	260.3665	291.2514	(62)
WWHRS	-34.4807	-30.4950	-31.9326	-26.4415	-24.6425	-21.0868	-19.7655	-21.0186	-21.8172	-25.7201	-29.1377	-33.8422	(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	(64a)
Output from w/h	260.1651	229.9564	244.3107	215.1985	208.7902	188.3664	186.2299	193.6027	195.6679	217.8753	231.2288	257.4093	(64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =			2628.8012 (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	121.7777	108.1041	115.6588	103.3852	101.4243	92.6831	92.3014	95.1695	95.3537	104.8034	109.6118	120.6490	(65)

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

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958	152.6958 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	205.5997	227.6283	205.5997	212.4530	205.5997	212.4530	205.5997	205.5997	212.4530	205.5997	212.4530	205.5997 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	407.6244	411.8543	401.1952	378.5032	349.8586	322.9367	304.9512	300.7213	311.3805	334.0725	362.7171	389.6390 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696	38.2696 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567	-122.1567 (71)
Water heating gains (Table 5)	163.6797	160.8691	155.4554	143.5906	136.3230	128.7266	124.0610	127.9160	132.4357	140.8648	152.2386	162.1627 (72)
Total internal gains	848.7126	872.1604	834.0591	806.3556	763.5900	732.9250	703.4207	703.0459	725.0780	752.3458	799.2175	829.2101 (73)

6. Solar gains

[Jan]												
					Area m2	Solar flux Table 6a		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d	Gains W
North					1.3300	10.6334		0.6300	0.7000		0.7700	4.3221 (74)
East					28.5100	19.6403		0.6300	0.7000		0.7700	171.1261 (76)
South					3.3700	46.7521		0.6300	0.7000		0.7700	48.1507 (78)
West					19.5000	19.6403		0.6300	0.7000		0.7700	117.0452 (80)
East					2.4300	26.6072		0.6300	0.7000		1.0000	25.6618 (82)
South					2.4300	42.0754		0.6300	0.7000		1.0000	40.5803 (82)
West					2.4300	26.6072		0.6300	0.7000		1.0000	25.6618 (82)
Solar gains	432.5481	829.5762	1337.4774	1924.5294	2347.5637	2401.1050	2286.6001	1969.4153	1545.3694	975.6891	536.0578	357.9685 (83)
Total gains	1281.2606	1701.7366	2171.5365	2730.8850	3111.1537	3134.0301	2990.0208	2672.4611	2270.4474	1728.0349	1335.2754	1187.1786 (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	31.6818	31.7542	31.8255	32.1645	32.2288	32.5313	32.5313	32.5879	32.4141	32.2288	32.0991	31.9646
alpha	3.1121	3.1169	3.1217	3.1443	3.1486	3.1688	3.1688	3.1725	3.1609	3.1486	3.1399	3.1310
util living area	0.9871	0.9696	0.9284	0.8296	0.6819	0.5159	0.3888	0.4463	0.6870	0.9084	0.9763	0.9898 (86)
MIT	18.5912	18.9864	19.5647	20.2354	20.6844	20.9050	20.9708	20.9550	20.7631	20.0795	19.1993	18.5304 (87)
Th 2	19.9438	19.9460	19.9481	19.9580	19.9598	19.9685	19.9685	19.9701	19.9652	19.9598	19.9561	19.9522 (88)
util rest of house	0.9846	0.9639	0.9150	0.7999	0.6314	0.4450	0.3030	0.3552	0.6177	0.8850	0.9708	0.9877 (89)
MIT 2	17.1177	17.6199	18.3459	19.1647	19.6730	19.9014	19.9545	19.9467	19.7763	19.0026	17.9012	17.0450 (90)
Living area fraction	17.4457	17.9241	18.6172	19.4030	19.8981	20.1248	20.1807	20.1712	19.9959	19.2423	18.1901	17.3757 (92)
MIT	17.4457	17.9241	18.6172	19.4030	19.8981	20.1248	20.1807	20.1712	19.9959	19.2423	18.1901	17.3757 (93)
Temperature adjustment												0.0000
adjusted MIT	17.4457	17.9241	18.6172	19.4030	19.8981	20.1248	20.1807	20.1712	19.9959	19.2423	18.1901	17.3757 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9754	0.9483	0.8934	0.7817	0.6282	0.4562	0.3211	0.3736	0.6199	0.8647	0.9574	0.9800 (94)
Useful gains	1249.8048	1613.7189	1940.0324	2134.7138	1954.3360	1429.7314	960.0732	998.4401	1407.5018	1494.1761	1278.4053	1163.4672 (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	3692.1580	3649.6731	3387.9386	2905.6571	2263.4775	1511.1936	979.4327	1029.7421	1618.5551	2386.1277	3074.3374	3667.8429 (97)
Space heating kWh	1817.1108	1368.1612	1077.2422	555.0792	230.0013	0.0000	0.0000	0.0000	0.0000	663.6120	1293.0711	1863.2555 (98a)
Space heating requirement - total per year (kWh/year)												8867.5333
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	1817.1108	1368.1612	1077.2422	555.0792	230.0013	0.0000	0.0000	0.0000	0.0000	663.6120	1293.0711	1863.2555 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8867.5333
Space heating per m2										(98c) / (4) =		36.9496 (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	1817.1108	1368.1612	1077.2422	555.0792	230.0013	0.0000	0.0000	0.0000	0.0000	663.6120	1293.0711	1863.2555 (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)	1968.7008	1482.2981	1167.1096	601.3859	249.1889	0.0000	0.0000	0.0000	0.0000	718.9729	1400.9438	2018.6950 (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)

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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	260.1651	229.9564	244.3107	215.1985	208.7902	188.3664	186.2299	193.6027	195.6679	217.8753	231.2288	257.4093	(64)
Efficiency of water heater	87.5632	87.3819	86.9864	86.0875	84.2773	79.8000	79.8000	79.8000	79.8000	86.3917	87.3063	87.6008	(216)
Fuel for water heating, kWh/month	297.1171	263.1624	280.8609	249.9765	247.7421	236.0481	233.3708	242.6099	245.1978	252.1946	264.8478	293.8436	(217)
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	42.7196	34.2712	30.8574	22.6075	17.4627	14.2671	15.9300	20.7065	26.8956	35.2885	39.8583	43.9069	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-111.5080	-145.9656	-194.8756	-202.8407	-205.6769	-187.1558	-184.4049	-179.9207	-170.9429	-158.1877	-118.3030	-97.7369	(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	-102.3672	-209.1371	-404.9448	-593.5373	-771.4357	-770.6738	-761.9663	-651.4777	-485.8732	-294.4360	-135.0344	-81.4735	(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												9607.2950	(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												3106.9716	(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)												344.7713	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-7219.8757	(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												5925.1622	(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	9607.2950	0.2100	2017.5319	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3106.9716	0.2100	652.4640	(264)
Space and water heating			2669.9960	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	344.7713	0.1443	49.7612	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1957.5186	0.1363	-266.7440	
PV Unit electricity exported	-5262.3571	0.1266	-666.3209	
Total			-933.0649	(269)
Total CO2, kg/year			1798.6215	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.4900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	9607.2950	1.1300	10856.2433	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3106.9716	1.1300	3510.8780	(278)
Space and water heating			14367.1213	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	344.7713	1.5338	528.8218	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1957.5186	1.5037	-2943.5386	
PV Unit electricity exported	-5262.3571	0.4648	-2446.0187	
Total			-5389.5573	(283)
Total Primary energy kWh/year			9636.4865	(286)
Target Primary Energy Rate (TPER)			40.1500	(287)